



Marine Ecology Assessment

GEMCO Excess Water Disposal

GEMCO

24 January 2025

→ **The Power of Commitment**

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Executive summary

Introduction

This report has been prepared to describe the marine ecological values within the marine environment of Milner Bay port area, within which the Excess Water Project (the Project) is located. This report presents the findings of a comprehensive assessment of marine ecology values and assesses the potential impacts to the marine ecological values associated with the construction and operation of the Project. Where necessary and/or appropriate, this report addresses how these impacts will be avoided and mitigated.

This report will be used to support assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Northern Territory *Environment Protection Act 2019* (EP Act). Where appropriate Significant Impact Assessments have been undertaken in accordance with relevant guideline documents.

Groote Eylandt Mining Company Pty Ltd (GEMCO) operates an open cut, strip-mining operation, producing high grade manganese ore on Groote Eylandt in the Gulf of Carpentaria in Northern Territory. The existing operation exports ore via GEMCO's port facility at Milner Bay (the Port), located adjacent the township of Alyangula, in the northwestern region of the island.

Deeper mining has resulted in greater groundwater intrusion within the quarries while progression of mining towards the coast has resulted in an increase in salinity within quarry water in some areas. To address this increase in quantity and salinity a marine outfall project (the Proposal) is being evaluated to allow an additional discharge solution of up to 80 GL pa of water from the quarries.

Project description

The Project, as relevant to this marine assessment, consists of:

- Construction of a pipeline, ocean outfall and diffuser marine infrastructure.
- Operation – discharge of up to 80 gigalitres per annum (GL/a) (hereafter referred to as marine discharge) and routine maintenance of the diffuser infrastructure.
- Decommissioning of infrastructure.

Methodology

A review of the existing ecological assessments, as well as publicly available databases and mapping layers was carried out to support understanding of the marine values of relevance to the Project area. Additionally, two marine field surveys were undertaken to supplement desktop assessments and provide seasonal context.

Conservation species and other protected matters of relevance to the Project have been identified, their likelihood of occurrence assessed, and significant impact assessments undertaken for those values confirmed, or likely to occur within the Study area.

This impact assessment has considered the potential impact pathways, and the application of appropriate avoidance and mitigation measures. The potential for significant residual impact has been assessed using the EPBC Significant Impact Guidelines 1.1 (DoE 2013).

Existing marine environment

The majority of the marine habitat surrounding Groote Eylandt can be described as high value, supporting species of conservation significance such as turtles and dolphins, as well as providing important habitat for commercial and recreational fishing activities. Extensive seagrass beds are present, and areas of Groote Eylandt are also recognised as important nesting habitat for green and hawksbill turtles.

In contrast to the majority of the habitat surrounding the island, Milner Bay, where the Project is located presents a lower value marine habitat. Seagrasses are sparse, conservation species are less frequently recorded within or immediately surrounding the area, and Traditional Owners have identified that the Port area does not provide high value fishing habitat.

As there is an operational Port at Milner Bay, the area represents a pocket of anthropogenic activity in an otherwise relatively untouched region. Activities in this area include operation of two jetties and associated docking and ship-loading facilities, maintenance dredging of berth pockets, turning bays and shipping channel, shipping and tug activities and associated generation of underwater noise, and the routine discharge of effluent from the sewage treatment facility in Alyangula.

The placement of the ocean outfall directly adjacent to the operating Port has sought to avoid areas of high environmental value and preferentially use the already heavily modified habitat within in the Port area to minimise the potential for impacts on environmental values as far as reasonably practical.

Of the conservation species (i.e. those protected under the EPBC Act, or those listed as threatened under the *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act)) found in the region, the following were confirmed to occur or considered likely to occur within 10 km of the Project (the Study Area):

- Seven species of marine reptile
- Twelve species of fish
- Three species of sharks and rays
- Five species of marine mammals
- Three biologically important areas for marine turtles were also identified.

The potential for significant impact to these conservation species was assessed using the EPBC Significant Impact Guidelines 1.1 (DCCEEW 2013).

Impact Assessment

The following table provides a summary of the potential sources, pathways and impacts identified for the Project. For each impact pathway, management and mitigation measures have been identified, including actions to be implemented during construction, operation and decommissioning.

Impact source	Impact pathway	Potential impact
Construction of marine infrastructure	Removal of benthic habitats	Habitat loss
	Increased suspended sediment concentration and light attenuation	Habitat degradation
	Introduction of marine pests and diseases	
	Altered coastal hydrodynamics, sediment transport and coastal processes	
	Accidental release of hazardous or polluting materials	
	Changes to habitat from the presence of physical structures	
	Vessel strikes or disturbance	Injury/mortality or disturbance
	Underwater noise from sheet piling and excavation of sediment	
	Artificial light	
Operation of pipeline / marine discharge	Introduction of marine pests and diseases	Habitat degradation
	Accidental release of hazardous or polluting materials	
	Altered water quality	
	Seabed scouring	
Decommissioning	Introduction of marine pests and diseases	Habitat degradation
	Erosion and increased turbidity and light attenuation	

	Accidental release of hazardous or polluting materials	
	Inadequate decommissioning	

Assessment of residual impacts, i.e. those impacts remaining following the implementation of the identified mitigation measures, was undertaken in accordance with the EPBC Significant Impact Guidelines 1.1 (DoE 2013).

The outcome of this assessment concluded that, with the application of the identified avoidance and mitigation measures, the potential for the Project to significantly impact on MNES and/or TPWC Act listed threatened species is considered unlikely. Further, the NT Environment Protection Authority's (EPA's) objectives for coastal processes, marine environmental quality and marine ecosystems will be met.

This report is subject to, and must be read in conjunction with, the limitations, assumptions and qualifications contained throughout the Report.

Acronyms and Definitions

Term	Definition
3D	Three dimensional
AASS	Actual acid sulfate soils
AHD	Australian Height Datum
AIMS	Australian Institute of Marine Science
ALA	Atlas of Living Australia
ALC	Anindilyakwa Land Council
ANC	Acid neutralising capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
AQIS	Australian Quarantine and Inspection Service
AUD	Australian dollar
BIA	Biologically Important Areas
CE	Critically Endangered
CEMP	Construction Environmental Management Plan
DAFF	Department of Agriculture, Fisheries and Forestry
dB	Decibels
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DD	Data deficient
DEPWS	Department of Environment, Parks and Water Security
DIWA	Directory of Important Wetlands of Australia
E	Endangered
EP Act	<i>Environment Protection Act 2019</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FS	Feasibility Stage
GEMCO	Groote Eylandt Mining Company Pty Ltd
GHD	GHD Pty Ltd
GL	Gigalitres
GPS	Global Position System
ha	Hectares
HAT	Highest astronomical tide
IMP	Invasive marine pest
IPA	Indigenous Protected Area
IPE	IndoPacific Environmental
IUCN	International Union for Nature Conservation
kg	Kilogram
km	Kilometre
km ²	Square kilometre

Term	Definition
L	Litre
LAT	Lowest astronomical tide
LOR	Limit of reporting
m	Metre
mg	Milligram
Mig	Migration
mm	Millimetre
MMP	Mining Management Plan
MNES	Matters of National Environmental Significance
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities
NIMPIS	National Introduced Marine Pest Information System
NL	Not Listed
NR Maps	Natural Resource Maps
NT	Northern Territory
NTU	Nephelometric Turbidity Unit
OBIS	Ocean Biodiversity Information System
OC	Organochlorine
OP	Organophosphate
pa	Per annum
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soils
PCB	Polychlorinated biphenyls
Planning Scheme	<i>NT Planning Scheme 2020</i>
PMS	Pump Management System
PMST	Protected Matters Search Tool
PTS	Permanent Threshold Shift
RMS	Root mean square
ROV	Remotely operated vehicle
s	Second
SDS	Safety data sheet
SEL	Sound exposure level
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound level pressure
SPRAT	Species Profile and Threats Database
Study Area	10 km buffer around the Project
TEK	Traditional Ecological Knowledge
the Port	Milner Bay
the Project	Excess Water Project
TPWC Act	<i>Territory Parks and Wildlife Conservation Act 1976</i>

Term	Definition
TRH	Total recoverable hydrocarbons
TTS	Temporary Threshold Shift
V	Vulnerable
VOC	Volatile organic compound
µPa	Micro pascal

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1. Introduction

1.1 Project background

Groote Eylandt Mining Company Pty Ltd (GEMCO) operates an open cut, strip-mining operation, on Groote Eylandt, in the Gulf of Carpentaria in Northern Territory (NT). The existing operation mines manganese ore by open-cut methods before processing the ore at an on-site facility. Manganese is then transported by road train to GEMCO's Milner Bay Port Facility (the Port) (Figure 1).

To access the manganese ore, existing vegetation is cleared, topsoil and overburden is removed, forming a large quarry. As mining intersects aquifers, water naturally collects within the quarry. The water is extracted, and a portion is typically used during operations with surplus water transferred between quarries and released to on-site bushland in accordance with the existing Mining Management Plan (MMP).

Deeper mining has resulted in greater groundwater intrusion within the quarries while progression of mining towards the coast has resulted in an increase in salinity within groundwater. To address this increase in quantity and salinity a marine outfall project (the Excess Water Disposal project (herein the Project)) is being evaluated to allow the discharge of up to 80 GL/a of water from the quarries.

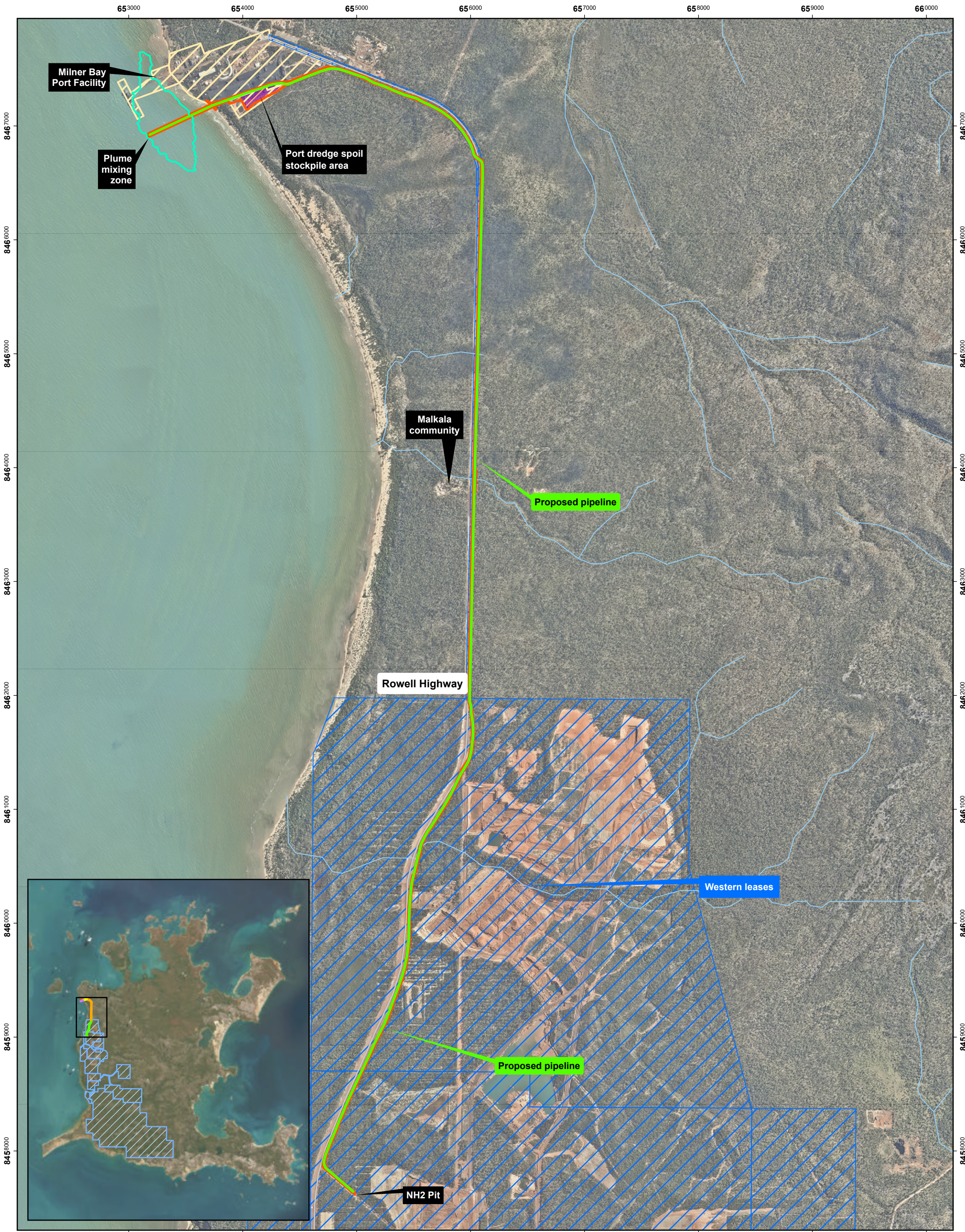
GEMCO is currently in the Feasibility Stage of the Project, which will include pipeline and pumping infrastructure from an existing northern quarry to a marine discharge point near the Port. The pipeline is planned to traverse adjacent to the Rowell Highway (road train haul route; Figure 1) and utilise areas of existing or historical disturbance as far as practical. The marine discharge outfall location was therefore chosen as the preferred option due to the already heavily modified habitat within the Port limits, relatively low environmental value of the benthic habitats in the area, and proximity to existing activities that are already causing localised environmental disturbance.

A referral under the *Environment Protection Act 2019* (EP Act) has been prepared to assess the potential impacts of the Project.

1.2 Project location

The Project comprises a pipeline that extends from the northern quarry area in the Western Leases along the Rowell Highway, traversing the Port's Special Purpose Lease area (Figure 1) and then extending into the marine environment approximately 320 m south of the ship loader jetty (Figure 2). The marine section of the pipeline will traverse from the high tide beach environment, extending into the marine environment for approximately 600 m, including a 145 m diffuser structure extending to a depth of approximately 9 m.

A 30 m wide construction corridor and a total construction footprint of approximately 1.84 ha within the marine environment have been used to inform the impact assessment. It should be noted that detailed design was not finalised at the time of the assessment. Further detail regarding the rationale for the location selection is provided in Section 2.2.





Paper Size ISO A4
0 50 100 150 200
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 53



South32 Group Operations Pty Ltd
GEMCO Excess Water Disposal Project

Project No. 12624084
Revision No. A
Date 15/07/2024

**Marine footprint and
predicted mixing zone extent**

FIGURE 2

1.3 Purpose of this report

This report has been prepared to describe the marine ecological values within the vicinity the Project, present the findings of a comprehensive assessment of marine ecology values and assesses the potential impacts to the marine ecological values associated with the construction and operation of the Project. Where necessary and/or appropriate, this report addresses how these impacts will be avoided and mitigated.

This report will be used to support assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Northern Territory *Environment Protection Act 2019* (EP Act). Where appropriate, Significant Impact Assessments have been undertaken in accordance with relevant guideline documents.

A separate report has been prepared to address the terrestrial components of the Project.

1.4 Structure of this report

Table 1 provides an overview of the structure of this report.

Table 1 *Structure of this report*

Report Section	Content
1. Introduction	– Providing a background on the Project, including location, the purpose of this report, and assumptions upon which the report is based.
2. Project description	– Definitions of project boundary terms used throughout the report (including mapping). – Detail regarding the marine component of the Project, upon which the impact assessment has been based is included. – Details regarding site selection that has been undertaken to avoid impact to sensitive areas.
3. Legislation	– High level overview of the legislation relevant to the marine component of the Project – Noting the guidance documents sourced from Government departments and technical organisations that have been referenced for the assessment.
4. Methodology	– Approach to desktop review of existing knowledge, including information sources used. – Approach to likelihood of occurrence assessment for conservation species – Approach to the impact assessment undertaken – Baseline field survey methodology implemented.
5. Existing marine environment	– Presenting the results of the desktop assessment for the Groote Eylandt region, including: • Overview of the marine habitats present in the region • Overview of fisheries relevant to the region including liaison with Traditional Owners • Review of the marine conservation species that have the potential to be present in the region – Presenting the results of the baseline monitoring and surveys that have been undertaken for the Project, including benthic habitat, water quality, sediment quality, macroinvertebrates and other marine species. – Overview of the quality of the water to be discharged, and results of the hydrodynamic modelling undertaken for the Project (reported in detail elsewhere).
6. Marine Matters of National Environmental Significance (MNES)	– A summary of the outcomes of the likelihood of occurrence assessment for conservation species and other MNES relevant to the marine environment. – Detailed likelihood of occurrence assessment is provided in Appendix B.
7. Potential impact pathways	– A review of the potential impact pathways associated with the construction, operation and decommissioning phases of the Project. – Detailed significant impact assessment undertaken in accordance with relevant guideline documents is provided in Appendix C.

Report Section	Content
8. Recommended impact management and mitigation measures	– Management and mitigations measures recommended to protect the marine environment as far as reasonably practical.
9. Residual impacts	– The outcomes of the assessment of the potential for residual impacts following the application of the recommended management and mitigation measures. – Detailed significant impact assessment undertaken in accordance with relevant guideline documents is provided in Appendix C; this includes the application of the recommended management and mitigation measures.
10. Conclusion	– A conclusion relating to the potential for significant impact on the marine environment
11. References	– A list of reference material utilised throughout the document
Appendix A	– Database reports obtained during the desktop assessment
Appendix B	– Detailed likelihood of occurrence assessment for all conservation species predicted to be present in the Study Area
Appendix C	– Detailed MNES significant impact assessment for all MNES that were assessed as 'confirmed to occur' or 'likely to occur'
Appendix D	– WSP Marine Benthic Survey (Summer – September 2023)
Appendix E	– GHD Marine Benthic Survey (Winter – June 2024)

1.5 Assumptions

This report has been prepared with respect to the following assumptions:

- The Project is in the Feasibility Stage, with the construction methodology and footprint at a concept level. A detailed design is being finalised during 2025, and therefore, elements of this report are subject to change.
- Site details established through Commonwealth and Northern Territory (NT) desktop assessments are correct and reflect current site conditions at the time the searches were conducted.
- Previous studies used to inform the preparation of this report are accurate and reflect site conditions at the time of writing this report.

This information presented in this report is based on the following:

- All assessments of potential impact are based on findings from desktop investigations and supplemented by the summer and winter marine surveys, as listed in Section 4.1 and Section 5.3, respectively. The level of confidence surrounding the likelihood of occurrence and potential impact on threatened species and communities is limited by information available on fauna, preferred habitat and occurrence records.
- The Protected Matters Search Tool (PMST) produces lists of threatened species, communities, and other MNES that have the potential to occur within the defined 10 km search area. It considers previous records and habitat modelling (where available); however, it does not confirm the presence/absence of threatened species and communities.
- The NT Government Department of Environment, Parks and Water Security (DEPWS) – Natural Resource Maps flora and fauna atlas database (NR Maps) is based on information recorded from previous surveys. Using the database, results of surveys in a defined geographical area can be searched to produce lists of species known to occur or known to have occurred in the case of extinct species. The accuracy of this is limited by the quality and quantity of data recorded from the desktop search extent. This does not necessarily reflect the survey effort, type or timing. For example, targeted surveys may have been undertaken, ineffective survey techniques may not yield accurate results, a large survey effort may yield few results and the data include incidental observations that were not part of a formal survey. Therefore, the database results (particularly the quantity of records) cannot be used as a definitive estimate of survey effort in a given area.
- Detailed analysis and confirmation of the provided preliminary benchmark values for water quality and sediment quality have not been undertaken in this report; preliminary benchmark values provided have been relied upon to inform potential impacts.

- Discharge modelling undertaken by GHD represent constant discharge rates and are unlikely to be representative of actual operations. The modelling therefore presents a worst-case scenario and has been relied upon in this report to inform potential impacts.
- Least concern species have not been mapped, hence distribution and density of non-threatened species locations across the Project area have not been assessed. NR Maps was utilised for nomenclature of mammals, reptiles and frogs. Species listed as near threatened, or data deficient (DD) under the *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act) that are not listed elsewhere (e.g. EPBC Act listed species) are not included in this assessment.
- Field surveys of benthic habitat were undertaken in September 2023 and June 2024.

1.6 Scope and limitations

This report has been prepared by GHD for GEMCO and may only be used and relied on by GEMCO for the purpose agreed between GHD and GEMCO as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than GEMCO arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Project description

2.1 Project footprint

The Project consists of the construction and operation of a pipeline, running from the existing mine along the Rowell Highway to an outfall location immediately south of the existing ship loader facility at the Port (Figure 2). The Project's construction is proposed to commence early 2026 with completion late 2026.

The overall project footprint is shown in Figure 1 while the various areas of relevance to the marine component of works for the purpose of the impact study are defined in Table 2.

Table 2 *Project boundary definitions*

Term	Definition
Project	All aspects of the GEMCO Excess Water Disposal Project, including construction and operation as outlined in Section 2.3.
Construction footprint / marine footprint	The construction footprint/marine footprint for the purpose of this assessment is defined as the area within the marine environment where the construction activities are proposed to occur and within which the pipeline will be placed, i.e. the area of the marine environment that will be directly impacted by the Project. This area has been calculated as 1.84 ha. It should be noted that this is a conservative estimate and most of this area will not be subject to permanent impact.
Study area	Construction footprint plus a 10 km buffer, used during desktop investigations and to assess the likelihood of occurrence of conservation listed species.
Project area	Area directly and indirectly impacted by the Project as far as can be feasibly predicted. The Project area comprises the Construction footprint, plus the mixing zone as predicted by the hydrodynamic modelling undertaken for the Project.
Survey area	This is the area that was subject to field assessment for the Project. The survey area comprises the Project area, plus habitat to the north and south of the Project area.
Groote Eylandt region	Used to refer to broader regional characteristics to contextualise the marine footprint
Marine environment	The marine environment is defined as all marine and coastal habitats up to the Highest Astronomical Tide (HAT) boundary.

2.2 Location rationale

As part of the Pre-feasibility Phase of the Project, extensive investment was made into understanding the potential locations for placement of the infrastructure in the marine environment. Consideration was given to the engineering feasibility of each option, as well as the financial investment required, and the potential for impact on the environmental and social values of the region.

Section 5 provides detail regarding the marine values of the region. In summary, the majority of the marine habitat surrounding Groote Eylandt can be described as high value, supporting species of conservation significance such as turtles and dolphins, as well as providing important habitat for commercial and recreational fishing activities.

In contrast to the majority of the island, Milner Bay, where the Port facility is located, presents a lower value marine habitat. Seagrasses are sparse, conservation species are less frequently recorded in the area, and the Traditional Owners (Bara and Jaragba) have identified that the area within the Port Limit does not provide high value fishing habitat (WSP, 2023). As there is an operational Port at Milner Bay, the area represents a pocket of anthropogenic activity in an otherwise relatively untouched region. The Port Limit is characterised by the following:

- Two jetties of approximately 400 m length and associated docking and ship-loading facilities.
- Marine export facilities catering to over five million tonnes of concentrate ore annually.
- Maintenance dredging of berth pockets, turning bays and shipping channels with associated turbidity generation within Port limits.

- Cargo ship anchorage locations.
- Tug berths and associated activities.
- Regular/routine maintenance of existing wharf infrastructure.
- Bulk cargo and small craft vessel movements through the Port limits.
- Underwater noise generation through routine Port activities.
- Routine discharge of sewage effluent from the Alyangula sewage treatment plant; discharge point located mid-way along the ship-loader jetty.

Following the hierarchy of controls, placement of the Project in the marine environment has sought to avoid the potential for impact as far as reasonably practical and minimise potential for impact where it could not be avoided. Therefore, despite the option of transferring mine water to and discharging at Milner Bay being the most expensive option, it has been selected as the preferred option. Key points that influenced this decision are summarised below and described further in Section 5.2.2 to 5.2.6:

- Avoidance of environmental values and sensitive or culturally valued areas by utilising low environmental value and heavily modified habitat within Port Limits.
- Further utilising an area that is already disturbed/modified and impacted by existing Port operations which include:
 - Cargo ship movement and loading activities
 - Underwater noise generation from Port activities and vessel movements.
 - Regular maintenance dredging of berth pockets and shipping channels.
 - Existing effluent discharge activity associated with the local sewage treatment plant.
- Availability of existing database of long-term water quality and sediment quality data (Section 5.2.1 and 5.2.2).
- Established knowledge of the Port area with regulatory agencies and local stakeholders.

2.3 Project activities within marine footprint

2.3.1 Construction

2.3.1.1 Outfall sump

Within the pipeline system, a concrete outfall sump will be constructed behind the beach zone (beyond the dunes). While the construction methodology and footprint of the outfall sump has not been confirmed, it is expected that the sump will be constructed via installation of a caisson ring shaft and excavation of dune sands from within the shaft (WSP, 2023).

2.3.1.2 Tidal and marine excavations

Pipeline installation will require excavation of sediment from the beach, through the intertidal zone and marine environment in order to bury the pipeline to a suitable depth to provide adequate protection from coastal processes.

Trenching is expected to be undertaken utilising temporary sheet piling to maintain trench integrity through the surf zone (approximately 200-300 m; approximately 5 m water depth). Marine sediments will then be excavated from between the piled sheets by a back-hoe dredge and barge, with excess material stored at the Ports' existing onshore dredge spoil ponds until reinstatement of the seabed via backfill is required post-pipeline burial. At the time of reporting, specific details relating to excavation volumes, timing and duration of works, were not available. It is however noted that trenching may not be limited to the coffer dam inside the sheet piles and may occur beyond the extent of the sheet piling. Following pipeline burial (refer Section 2.3.1.3), all temporary sheet and supporting tubular piles will be removed.

Sheet and tubular piles associated with the above works are proposed to be installed via vibratory piling during construction:

- Parallel sheet piles (walls) are proposed to be placed through the intertidal and surf zones. The sheet piles will be removed after the installation of the pipeline.
- Tubular piles will be placed along the outside of the sheet piles to provide stability to the structure during trenching. These piles will be removed after the installation of the pipeline.

Where reinstatement is not possible, excavated/dredged materials will be handled and stored in the existing onshore dredge spoil ponds.

2.3.1.3 Pipe-laying

The marine pipeline, manufactured from high-density polyethylene (HDPE) with an internal diameter of 1,400 mm, will be approximately 600 m long, from the beach sump, including the diffuser structure (WSP, 2023). From the sump, the pipeline is expected to be laid within a trench through intertidal zone and the surf zone (approximately 200-300 m) to an expected cover depth of 1.4 m (depth of sand above the top of the pipeline).

As the pipe is laid, single lengths of pipe will be prepared onboard the pipelay vessel. As the vessel moves away from shore the pipe will slowly exit the pipelay vessel, curving downward through the water and laid in the trench.

Marine sediment removed during the open-cut trenching will be replaced to cover the pipe and backfill the trench. At approximately 5 m water depth (LAT) the pipeline will emerge and continue along the seabed to the diffuser at approximately 10 m water depth (LAT), approximately 600 m¹ offshore from the LAT line. At the time of assessment, construction details such as volumes, timing and duration of works, have not been provided. The impact assessment (refer Section 7) is based on concept design available information which is considered 'worst case'.

2.3.1.4 Pipe Collars

Pipe collars will be installed on the pipe to secure the pipeline to the seafloor and stabilise against loads. Pipe collars of approximately 9,500 kg (dry weight) constructed from marine-grade concrete will be used and spaced at approximately 6 m intervals (WSP, 2023).

The collars will be installed on the pipeline prior to them being floated out and deployed using the S-lay method. Collars will be secured to the seabed under their own weight, two feet will protrude on either side of the bottom providing extra stability.

The seaward end of the pipeline will be kept in place by two piles, to be installed using vibratory piling.

2.3.1.5 Diffusers

The concept design and dispersion modelling selected a 145 m long diffuser, manufactured from HDPE and consisting of 30 alternating diffusion ports spaced at 5 m intervals, discharging in a north-westward and south-eastward direction at the seabed with an average depth of 8.5 m. A summary of diffuser configuration adapted from the *Marine Concept Study* prepared by WSP in 2023 (WSP, 2023) is provided in Table 3 below.

Table 3 Diffuser configuration

Parameter	Value
Number of ports	30
Port spacing	5 m
Diffuser length	145 m
Average discharge depth	-8.5 m CD (-9.79 m AHD)
Port diameter	150 mm
Port length	600 mm
Port height above seabed	1.6 m
Vertical angle (from horizontal)	10 degrees
Horizontal angle (bearing)	340/160 degrees

¹ Distance based off marine footprint kmz file received 9th June 2024

Parameter	Value
Exit velocity	3.6 m/s

2.3.1.6 Vessel use

Numerous vessels will be utilised during trenching, piling, and pipe laying, as well as during activities associated with infrastructure installation including but not limited to:

- Small watercraft
- Barges and jack-up barges
- Pipe-laying vessel.

2.3.2 Operation

During operation the pipeline will be used to transfer excess mine water from the mine to the ocean outfall location at the Port. The system is designed to release up to 80 GL/a (hereafter referred to as marine discharge). This estimate represents peak levels, with discharge generally expected to be below 80 GL/a. Discharge rates will be dependent upon water management requirements at site. Discharge is expected to occur for the majority of the time, however it is expected that there will be periods when no water will be discharged to the marine environment.. This may occur based on site water use requirements, or during pipeline maintenance activities.

Refer to Section 7.2.1.1 for detail on discharge water physiochemical and chemical characteristics.

To support an understanding of the potential for impact as a result of the Project's operation, marine discharge modelling has been undertaken. Further detail regarding the modelling is described in Section 7.2.1.2. An environmentally conservative approach has been undertaken whereby the peak discharge has been used for modelling and impact assessment.

To support operations, routine maintenance of the diffuser infrastructure is required. This may include removal of any biofouling from diffuser outlets, and repairs as needed, with associated vessel usage to support these activities.

2.3.3 Decommissioning

Decommissioning of infrastructure will need to be considered and addressed at the end of life/mine closure as part of a future Decommissioning Plan. There are generally two options for decommissioning: retaining marine infrastructure in place, or partially removing the outfall pipe and/or diffuser structure from the seabed.

Both options have been considered under the impact assessment for the Project.

3. Legislation

The Project is subject to both Commonwealth and Northern Territory legislation and regulatory requirements. A summary of marine ecosystem relevant legal, policy and guideline frameworks and their context to the Project is provided in Table 4.

Table 4 Key legislation, policies, and guidelines relevant to marine ecosystems

Legislation	Descriptions
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act)	The Commonwealth EPBC Act provides a framework for protection of the Australian environment, including its biodiversity, and its natural and culturally significant places. The EPBC Act focuses Australian Government interests on the protection of MNES – nationally-significant animals, plants, habitats, or places – with the states and territories having responsibility for matters of state and local significance. Relevant to marine ecosystems and the assessment within this report are the following protected MNES: – Listed threatened and conservation-dependent species – Listed migratory species (protected under international agreement) – Listed marine and cetacean species
<i>Environment Protection Act 2019</i> (NT) (EP Act)	The EP Act is applicable to all projects undertaken within the NT that have the potential to cause environmental impacts. A referral must be made to the NT EPA if a self-assessment under the NT EP Act Self-Assessment Tool concludes that a significant impact is likely. The NT EPA then determine the assessment process based on the information provided in the referral documentation. Relevant to the marine ecosystems and the assessment within this report are the following Environmental Factors: – Sea – coastal processes – Sea – marine environmental quality – Sea – marine ecosystems
<i>Fisheries Act 1988</i> (NT)	The NT <i>Fisheries Act 1988</i> is purposed primarily to manage the aquatic resources of the NT including an acknowledgement of the rights and interests of Aboriginal people and resources. A permit will be required for activities that cause shock, sound, or other vibration under water, which includes construction activities associated with the Project.
<i>Planning Act 1999</i> (NT)	The NT <i>Planning Act 1999</i> provides for land use planning and land use control in the NT. Under the NT <i>Planning Act 1999</i> (Planning Act), permits may be required for land use or building development requiring consent under the Planning Act.
Northern Territory Planning Scheme 2020	The NT Planning Scheme 2020 (Planning Scheme) is the NT's 'rule book' for land use planning and development. The Planning Scheme does the following: – Describes how land use may change to meet future needs – Identifies factors and risks that could affect land use (e.g. flooding) – Sets controls that allow, prohibit, or put conditions on land use – Provides guidance to help consent authorities make decisions – States the level of flexibility allowed for decisions about development applications
<i>Territory Park and Wildlife Conservation Act 1976</i> (NT) (TPWC Act)	The TPWC Act aims to establish NT parks and reserves and protect and conserve NT wildlife that is listed as threatened, including essential habitat. Relevant to marine ecosystems and the assessment within this report are the following protected wildlife under the TPWC Act: – Listed threatened species
<i>Water Act 1992</i> (NT)	The NT <i>Water Act 1992</i> provides for the investigation, allocation, use, control, protection, management, and administration of water resources, including extraction of groundwater, marine discharge management and water pollution. The Water Act also provides for water allocation plans, drilling licenses, bore construction permits, water extraction licenses, waste discharge licenses, fees and charges, and penalties for offences.

Additional published resources sourced from government departments and technical organisations have been used to support the understanding of the existing environment and associated assessment of potential impacts, as summarised below:

- Approved conservation advice and recovery plans for threatened species (as provided by the Department of Climate Change, Energy, the Environment and Water (DCCEEW)).
- NT EPA Environmental factors and objectives - Environmental impact assessment - General technical guidance (DEPWS 2022).
- Northern Territory technical guidance on environmental impact assessment requirements and expectations.
- Northern Territory Land Clearing Guidelines (DEPWS 2021) – as related to marine plants, including mangroves, salt couch and samphire.
- EPBC Act – Matters of National Environment Significance: Significant Impact Guidelines (DoE, 2013).
- Technical plans and guidelines for understanding threats and developing mitigation measures:
- Approved conservation advice and recovery plans for threatened species (as provided by DCCEEW).
- Marine Bioregional Plans for the North Marine Area (DSEWPC 2012b).
- Water Quality Objectives for the Darwin Harbor Region (NRETAS 2010).
- Underwater Piling Noise Guidelines (DPTI 2022; under review).
- Environmental Assessment Guidelines for Protecting Marine Turtles and Light Impacts (WA EPA 2010).
- National Guideline for Light Pollution for Wildlife (DCCEEW 2023e).
- Guidelines on Waste Discharge Licensing under the Northern Territory *Water Act 1992* (NT EPA, 2020).
- Guidelines on mixing zones under the NT EPA (NT EPA, 2013).
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).
- Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (National Marine Fisheries Service 2016).
- National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Australian Government 2017).

4. Methodology

4.1 Desktop assessment

4.1.1 Publicly available databases

A desktop assessment was undertaken in January 2024 to inform the marine environmental values of the Project area. The relevant government databases, mapping layers, historical and contemporary surveys reviewed in the desktop assessment are summarised in Table 5. Database outputs are found in Appendix A; information from these outputs has been incorporated into Section 5 (Existing Environment), and has informed assessment of impact pathways, avoidance and mitigation measures, and residual impacts discussed in Section 7 to Section 9, respectively.

Table 5 Desktop assessment information sources

Desktop search	Purpose
Atlas of Living Australia (ALA) Database	The ALA database was searched to retrieve historical records of conservation significant flora and fauna species assessed as likely to occur within and near the Project area.
Australian Marine Spatial Information System	The Australian Marine Spatial Information System interactive map was searched to obtain information pertaining to maritime boundaries, petroleum, fisheries, regulatory, environment, Native Title, and offshore mineral matters of relevance to the Project area.
Department of Environment, Parks, and Water Security (DEPWS) Natural Resource Maps (NR Maps)	NR Maps was used to identify spatial information on land tenure, planning, geology, soils, water, flora, fauna, weeds, and other environmental values.
Directory of Important Wetlands of Australia (DIWA)	The DIWA database was searched to understand if any nationally important wetlands are present within the Study area.
National Conservation Values Atlas	The National Conservation Values Atlas was searched to obtain information for marine related matters, including World Heritage properties, Ramsar wetlands, migratory marine species, biologically important areas, and nesting areas of relevance to the Project area.
National Introduced Marine Pest Information System	The NIMPIS describes the biology, ecology and distribution of marine pest species introduced to Australia and highlights species that are at risk of being introduced.
NT Government Threatened Flora and Fauna Database	The NT Government Threatened Flora and Fauna profiles were assessed to determine habitat requirements and ecology of potentially occurring conservation significant species.
Protected Matters Search Tool (PMST)	The Commonwealth DCCEEW PMST search was conducted to identify MNES protected under the EPBC Act that have the potential to occur within the Study area. The PMST output is provided in Appendix A.
Species Profile and Threats Database (SPRAT)	The DCCEEW SPRAT profiles were assessed to determine habitat requirements and ecology of potentially occurring conservation significant species.
Turtle Nesting Distribution Abundance and Migration	Maps of the known distribution of turtle nesting sites for the world's seven marine turtle species

4.1.2 Knowledge review

A number of ecological and environmental assessments have been undertaken within or nearby to the Project area. These have been used to support understanding of the marine values of relevance to the Project area. The field surveys and associated technical reports used during the desktop assessment are outlined in Table 6.

Table 6 Previous ecological and environmental assessments undertaken for the Project

Year	Author	Report title
2024	GHD	Mixing zone assessment for pH
2023	WSP	Marine Ecology Baseline Assessment – Desktop Report
2023	GHD	GEMCO Excess Water Disposal Project Marine Discharge Modelling Report
2023	Australian Institute of Marine Science	Nesting density and Movement Patterns of Green Turtles on Groote Eylandt
2023	Indo-Pacific Environmental	Development of Water Quality Benchmark Values for Discharge to Marine Environment
2023	Indo-Pacific Environmental	Volume weighted assessment of dewatering discharge pH
2023	WSP	WP05: Environmental Baseline Assessment and Studies – Phase 2 – Marine Habitat Mapping
2022	Indo-Pacific Environmental	GEMCO Tug Replacement Project Dredging Pre-Referral Report
2022	South 32	FY22 GEMCO Environmental Mining Report
2021 2019 2017 2015	GEMCO	Biota Results (Hydrocarbons) - csv.file
2021 2019 2017 2015	GEMCO	Biota Results (Metals) - csv.file
2019	Australian Institute of Marine Science	The Groote Eylandt fish diversity assessment and predictive habitat mapping Report
2019	Department of Environment, Parks and Water Security	Dugong distribution and abundance in the Gulf of Carpentaria, Northern Territory: October 2019

4.2 Likelihood of occurrence assessment

A ‘likelihood of occurrence’ assessment was undertaken for EPBC Act and TPWC Act listed marine species. Terrestrial species likelihood of occurrence is assessed in the Terrestrial Ecology Assessment Report (GHD, 2024a). Data used to inform the assessment include the PMST report of the Study area, previous species records in the Groote Eylandt region, and instances where important habitat is present in the Project area (i.e. when assessing cryptic species such as Syngnathidae). The likelihood of occurrence assessment criteria are provided in Table 7. The results of the assessment are presented in Appendix B and summarised in Section 7.2.1.2

The likelihood of occurrence assessment (Appendix B) was based on a review of species distributions and habitat requirements, historical records for the region, and the results of habitat assessments and ecological field surveys conducted within the Study area using the combined pool of information reviewed during the desktop assessment.

For species “confirmed to occur” and “likely to occur” within the Study area, a significant impact assessment has been undertaken with the results presented in Appendix C and summarised in Section 9.2.

Table 7 Likelihood of occurrence assessment criteria

Category	Criteria
Confirmed to occur	Species has been recorded within the Study area during field assessments within the last five years.
Likely to occur	Species has been documented within literature as occurring within the Study area (ALA/NR Maps) and suitable habitat is present in the Study area. Comprehensive field surveys have not been undertaken or were undertaken in sub-optimal conditions or the species is highly cryptic and/or very short-lived.
May occur	Species distribution incorporates the Study area, but only marginal habitat is present. Alternatively, suitable habitat is present, but the species has not been historically recorded in the Study area.
Unlikely to occur	Species has not been historically recorded in the Study area and current known distribution does not encompass the Study area or suitable habitat is generally lacking from the Study area.

4.3 Impact assessment methodology

The impact assessment undertaken for the Project comprised a number of steps:

- Potential impact pathways related to the construction, operation and decommissioning were identified and examined in detail. Reference was made to the Project activities as described in Section 2.3, as well as the existing environmental values as described in Section 5.
- Appropriate, achievable avoidance and mitigation measures were identified for each potential impact pathway, as relevant to each sensitive receptor.
- The potential for residual impact was assessed; residual impact is defined as the potential impact remaining following the application of identified avoidance and mitigation measures. For conservation significant species/matters protected under the EPBC or TPWC Act the potential for significant impact was assessed using the EPBC Significant Impact Guidelines 1.1 (DoE 2013).
- A conclusion was formed based on the outcomes of the residual impact assessment.

4.4 Project area field survey methodology

Baseline marine surveys were conducted by WSP in September 2023 (summer survey) and GHD in June 2024 (winter survey) to assess the benthic marine habitat within the Project area including the marine footprint and predicted mixing zone, and at areas immediately to the north and south of the Project area. This area is collectively referred to as the Survey area. Additionally, opportunistic water quality and sediment quality sampling was also undertaken during the winter survey to supplement the existing historical water and sediment data.

Survey methodology for the summer and winter surveys are summarised in Section 4.4.1 and Section 4.4.2, respectively, with detailed methodology provided in Appendix D and Appendix E, respectively.

The findings and analysis of the benthic habitat surveys are summarised in Section 5.3 while the additional water and sediment sampling data is summarised in Section 5.2.1.1 and 5.2.3.1, respectively.

4.4.1 Summer survey methodology

- Video footage of the seafloor within the Survey area was obtained using a small remotely operated vessel with a live feed video camera connected via a tether line to a laptop on the survey vessel. The beginning and end position of each transect was recorded as waypoints using a handheld Global Position System (GPS) unit.
- Video transects covered a range of distances, depths, and bearings to provide representative coverage of the survey area. This was undertaken to provide an understanding of the types and distribution of marine benthic habitats and to achieve the survey purpose.
- Each video file was reviewed to identify points of interest to establish the variety of habitat types based on key ecological characteristics.

4.4.2 Winter survey methodology

- Survey transects were pre-defined according to the transects conducted by WSP in the previous September 2023 survey to enable comparison of like-for-like benthic habitat to assess for potential seasonal changes.
- Marine habitat was assessed using a combination of vessel-based tow and drop camera video footage enabling live-video feed and recording of underwater video.
- For towed transect footage, the camera housing unit was lowered to approximately 2 m above the seabed. Footage was viewed in real time and presence of marine plants (seagrass/macroalgae) as well as any other features of interest (rock, coral, fauna etc) recorded.
- Wherever visibility in the towed footage was restricted (i.e. out of focus, dark etc) or a point of interest was identified for further investigation, a drop camera was utilised to capture additional footage.
- Surface water samples were taken at approximately 30 cm water depth for lab analysis using a pole with sampling container attached.
- Surface sediment samples were collected for lab analysis using a van Veen grab capable of retaining approximately one litre (L) of material. A minimum of three replicate grabs were collected per sample location to ensure that the appropriate mass of sediment had been collected (~3 kg) and then homogenised. If sufficient sediments were not retrieved in three attempts, additional grabs were conducted until the required volume was obtained.
- All water and sediment samples were analysed by a National Association of Testing Authorities (NATA) accredited laboratory.

5. Existing marine environment

This section provides an overview of the existing marine environment within the Study area and provides context for the impact assessment. The geographic area covered by the construction footprint, Project area and Study area is presented in Section 5.1 provides and overview of the existing environment of the Groote Eylandt region, while Section 5.2 provides details regarding the Milner Bay Project area, including the marine footprint of the Project.

5.1 Groote Eylandt region

Groote Eylandt is located off the NT coast, in the Gulf of Carpentaria and is within the North Marine Region. The island has a tropical climate, characterised by wet summers and dry winters. During the wet season (November – March), the climate is characterised by high temperatures, high humidity, monsoon rainfall and storms with an occurrence of tropical cyclones in the wider region. In comparison, the dry season (April – October) experiences cooler temperatures, lower humidity, and significantly less rainfall.

The Anindilyakwa Indigenous Protected Area (IPA) was originally declared in 2006 over the islands in the Groote Archipelago, including Groote Eylandt (Figure 3). The IPA was extended in 2016 to cover a total area of 10,000 km² by including 7,000 km² of sea country, providing an area of cultural importance for the Traditional Owners (Anindilyakwa IPA 2024). The IPA is also of environment and conservation importance, supporting over 900 species of plants, over 150 species of marine fish, and at least 330 species of terrestrial vertebrates.

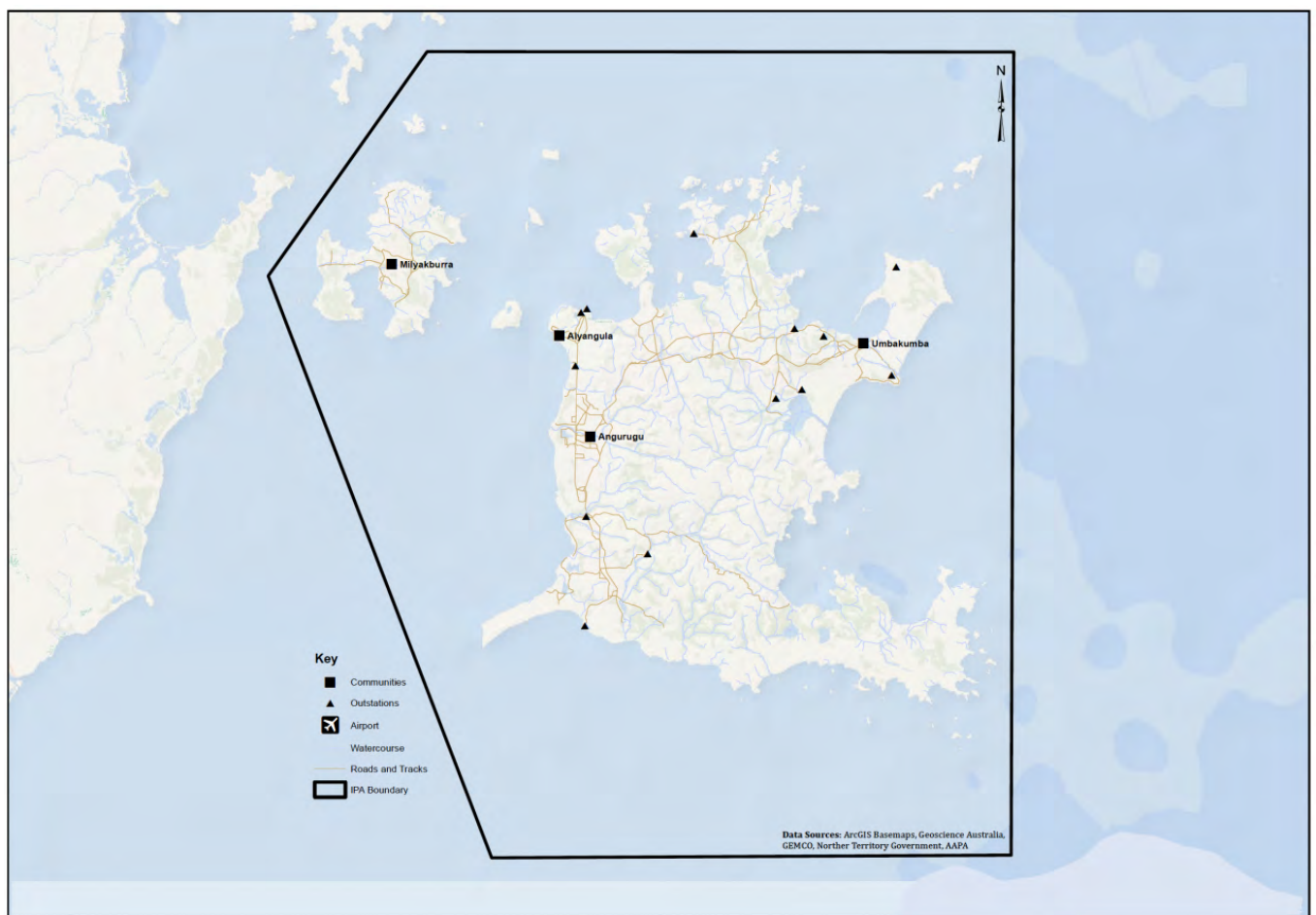


Figure 3 Groote Eylandt and Indigenous Protected Area boundary

The island provides nesting habitat and biologically important areas for three threatened marine turtle species (flatback turtle (*Natator depressus*), green turtle (*Chelonia mydas*), and hawksbill turtle (*Eretmochelys imbricata*)), foraging habitat for several migratory shorebird species, and contains several internationally significant seabird rookeries.

Tidally, the Gulf of Carpentaria region is complex due to the influence of the Pacific and Indian Oceans merging, the shallow bathymetry, and the degree of ocean interaction with the atmosphere (Smith et al. 2013). Groote Eylandt typically experiences diurnal tides characterised by strong clockwise circulation during flood tides (Condie et al. 1999).

The west coast of Groote Eylandt is characterised by broad sandy beaches, rocky outcrops with reef forming epifauna, sparse seagrass and patches of other aquatic flora.

5.1.1 Marine environment

A collaboration between the Anindilyakwa Land Council (ALC), Australian Institute of Marine Science (AIMS) and local Traditional Owners mapped the benthic marine environment under the 'Mapping Makarda' Project in 2016 (Davies et al., 2020). The compiled map of Traditional Ecological Knowledge (TEK) of marine habitats around Groote Eylandt is summarised in Figure 4 (noting that this mapping is based on local knowledge and to our knowledge has not been ground-truthed). The Groote Eylandt coastal areas are characterised by stretches of patch reef in the west, south and east, corals in the northeastern area of the island, as well as areas of coarse sand in the nearshore zones (Figure 4).

Thirteen seagrass species have been recorded in the Gulf of Carpentaria and are distributed by depth zones, ranging from intertidal to 38m below mean sea level (Carter et al., 2024). Along the western coast of Groote Eylandt, previous surveys identified multiple seagrass species (*Thalassia hemprichii*, *Syringodium isoetifolium*, *Halodule uninervis* and *Halophila ovalis*²); however, these survey efforts were conducted in early 1990. Small areas of seagrass are noted in shallow areas on the west, southwest and northern coastlines (Figure 4). Of note, the area adjacent to Alyangula and Milner Bay broadly consists of coarse sand with patch reefs with seagrass in the southern portion of the Bay (Trott, 2012).

Benthic epifauna/epibiota are those organisms that live on the surface of the seabed, generally attached to submerged structures, flora, or other fauna. Long et al. (1995) concluded deposit-feeding epifauna are more abundant than suspension-feeding epifauna within the Gulf of Carpentaria, an expected consequence of high currents and turbid waters. In 2021, a four-day survey was conducted to complete an expansive knowledge gap of Annelida (including polychaetes and sipunculids) off the coast of Groote Eylandt in a range of environments (Medeiros et al., 2021). Thirty-four new species were recorded, included the first records of Nemertea and Platyhelminthes.

Baseline benthic habitat monitoring, baseline water quality monitoring and baseline sediment quality monitoring for Milner Bay and the Project area has been consistently reported since 2013 and are summarised in Section 5.3, Section 5.2.1 and Section 5.2.2.

² *Caulerpa serrulata* and *Caulerpa rotunda* were also noted in Trott 2012 as being recorded during the surveys

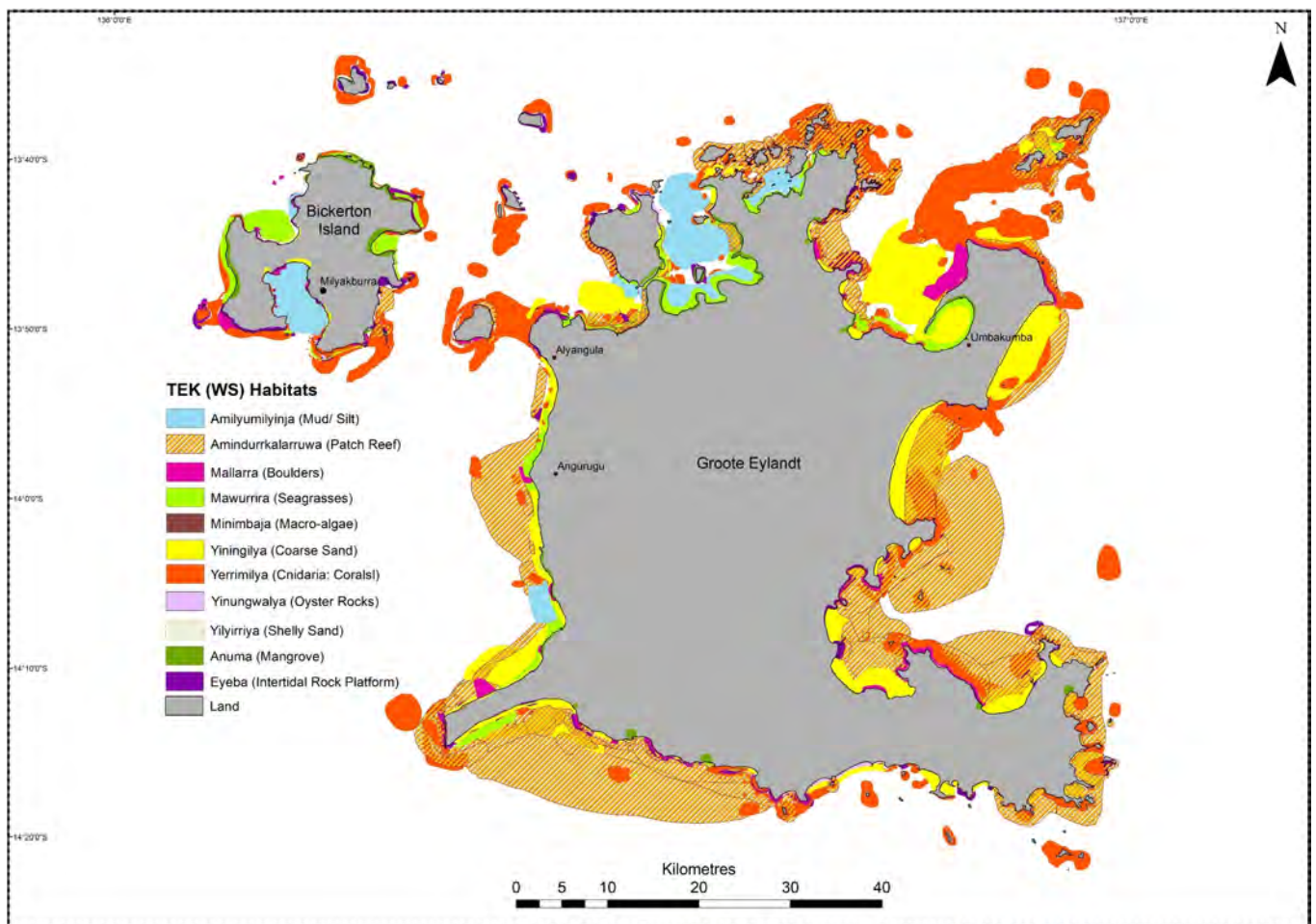


Figure 4 Broad-scale marine habitat distribution based on Anindilyakwa TEK in collaboration with Anindilyakwa Land Council and AIMS, as published by Davies et al., 2020

5.1.2 Socio-economic and commercial species

5.1.2.1 Fish

The marine environment surrounding Groote Eylandt contains coral reefs, rocky intertidal areas, seagrass beds, sponge gardens, and open soft-sediment habitats; and as such, supports a diverse range of fish species (for marine species specific to Milner Bay and the Project area, refer to Section 5.2.5).

AIMS undertook a fish diversity assessment and predictive habitat mapping in 2016 and 2017 around the north, east and south of the island, where marine habitat supporting fish diversity are more abundant. Surveys completed by AIMS identified 239 fish species (52 families and 125 genera) and included a diverse range of trophic groups (carnivores, herbivores, omnivores, planktivores, corallivores). Diversity and abundance were highest in shallow environments compared to either deep or intertidal areas and is likely a reflection of habitat diversity and complexity is generally higher in shallower environments.

Fish species common in shallow complex environments included wrasse (*Thalassoma* sp.), parrotfish (*Scarus* sp.), coral trout (*Plectropomus* grp) and cod (*Plectropomus* sp. and *Epinephelus* sp.) while fish species associated with deeper, soft substrate environments included mackerel (*Scomberomorus* spp.), threadfin brems (*Nemipterus* sp. and *Pentapodus* sp.), schooling scad (*Selaroides* sp.) and hammerhead sharks (*Sphyrna* sp.). Furthermore, multiple fishing charters operate around Groote Eylandt, targeting barramundi (*Lates calcarifer*) and other sport saltwater species.

Stakeholder engagement by GEMCO representatives with Bara and Jaragba Traditional Owners on 24 October 2023 identified that the areas to the north and south of the Port are used by local communities for fishing however the area within the Port Limits is not used. Furthermore, no commercial fishing activities are known to occur within the Port Limits. It is therefore apparent that the Project area, being within Port limits, does not represent high value recreational fishing grounds for locals or the commercial fishing industry.

5.1.2.2 Prawns

The North Prawn Fishery region (from Cape York in Queensland to Cape Londonderry in Western Australia, including the Gulf of Carpentaria; Figure 5) is an important fisheries ground for commercial prawn species. Commercial ventures in the Northern Prawn Fishery are worth \$76.6 million AUD (AFMA, 2024) and targets multiple species, including *Penaeus merguensis*, *P. indicus*, *P. esculentus*, *P. semisulcatus*, *Metapenaeus endeavouri*, and *M. ensis*.

The northwest of Groote Eylandt has been described as a closure area due to seagrass meadows found throughout the area and their importance to the penaeid prawn lifecycle. During development, seagrasses serve as a nursery for several months, from the larval phase until subadult phase. Following their development to subadult, penaeid prawns form burrows in the substrate until they reach the adult stage.

The Australian Fisheries Management Authority (AFMA) manages the Northern Prawn Fishery, preventing overexploitation by restricting harvesting boat quantities, regulating fishing gear and providing closures, both spatially and temporally. One of those closures in force within the Northern Prawn Fishery is the Alyangula area of Groote Eylandt, within which the Project area is located, and is spatially delineated in Part 5, Schedule 1 – Northern Prawn Fishery – Directions and Closures 2023 (AFMA, 2023). As the Project area lies within the Alyangula closure area, this area is not applicable to the Fishery.

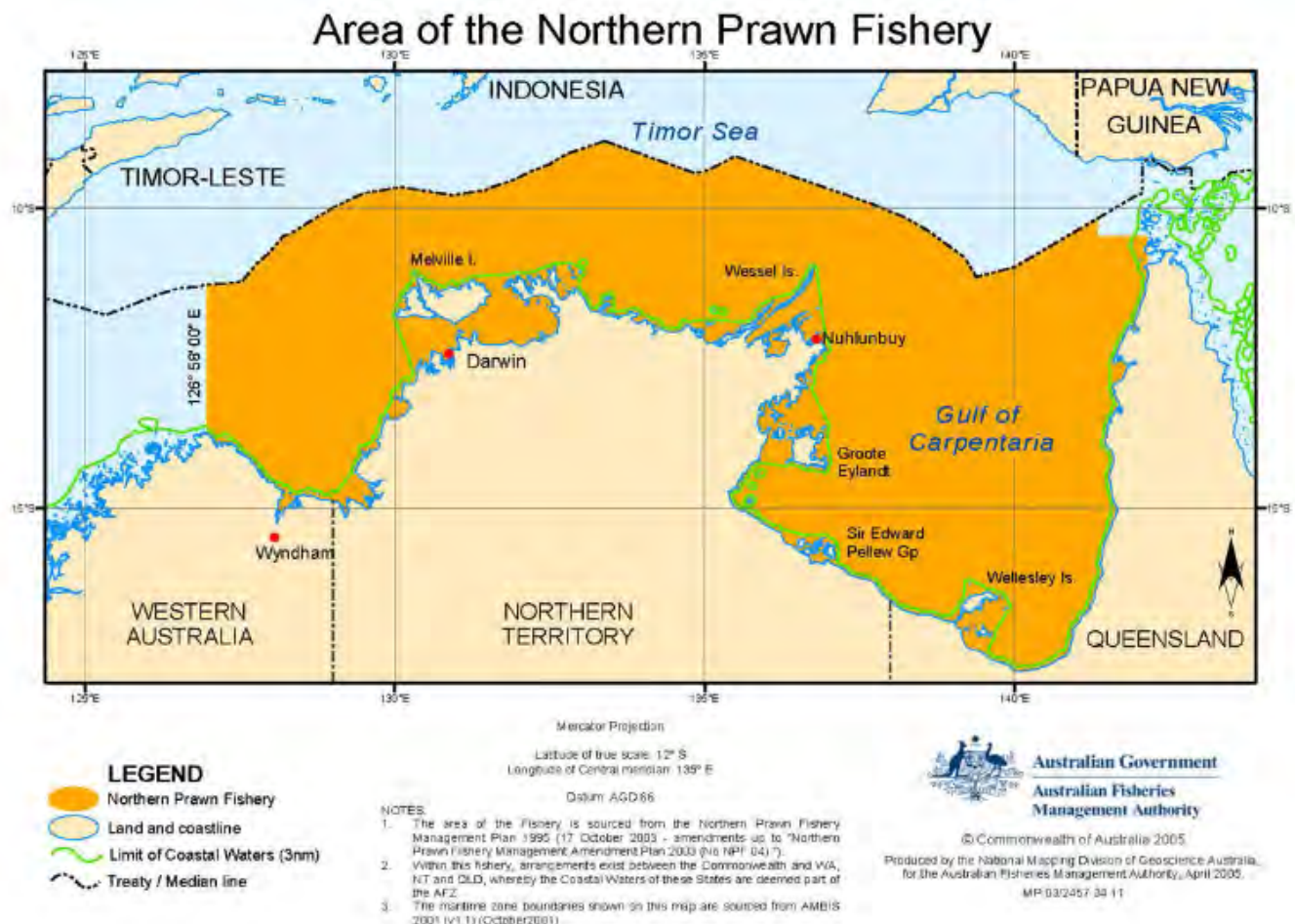


Figure 5 Northern Prawn Fishery boundary extent (AFMA, 2024)

5.1.2.3 Sea cucumbers

Sea cucumbers (also known as trepang) are commercially harvested in the NT, from the high-water mark to three nautical miles seaward from the territorial sea baseline (DITT 2021). Trepang fisheries in Northern Australia date back to the early 1700s; although, current fishing efforts are restricted to only six commercial trepang licences. Fishing efforts are spread along the Arnhem Land coast, with a concentration of fishing around the Cobourg Peninsula and near Groote Eylandt (outside the Project area).

Recent harvesting efforts have exclusively harvested the sandfish (*Holothuria scabra*), although five other sea cucumbers species (lollyfish (*Holothuria atra*), black teatfish (*Holothuria whitmaei*), white teatfish (*Holothuria fuscogilva*), deepwater redfish (*Actinopyga echinities*) and prickly redfish (*Thelenota ananas*)) are permitted for commercial harvest under trepang licences (DITT 2021).

All six species are listed on the International Union for Nature Conservation (IUCN) Red List of Threatened Species as either endangered or vulnerable, however this listing is based on the global status of the species (DITT 2021). Sea cucumber populations around mainland Australia are healthy and viable, and as such, are not listed under Commonwealth, NT, or international legislation for protection.

5.1.3 Conservation species

Conservation species considered in this assessment comprise those listed under the TPWC Act, and/or those listed under the EPBC Act. All species of relevance to this assessment that were listed under the TPWC Act were also listed under the EPBC Act. Information regarding these species is provided following, with detailed information relating to likelihood of occurrence and significant impact assessments provided in Appendix B and Appendix C.

5.1.3.1 Marine turtles

Six (of the seven worldwide) species of marine turtle are known to inhabit waters of the Gulf of Carpentaria and are listed as threatened species under the EPBC Act and the TPWC Act. The waters around Groote Eylandt contain important areas for breeding, nesting, and feeding for multiple turtle species, with globally significant breeding populations of green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and flatback turtle (*Natator depressus*) (Commonwealth of Australia, 2017). Clusters of turtle records in the Groote Eylandt region aggregated by OBIS-Seamap are shown across Figure 6 to Figure 9 and indicate areas of high turtle activity in the region (Halpin et al., 2009; Uldyower et al., 2023).

The Recovery Plan for Marine Turtles in Australia (Australian Government 2017) lists Groote Eylandt as an important nesting area for the Gulf of Carpentaria stock of green turtle and for the north-east Arnhem Land stock of hawksbill turtles. Nesting of flatback turtles from the Arafura Sea stock of flatback turtles also occurs on Groote Eylandt. Nesting of all three species occurs mostly on the southern and eastern shores of Groote Eylandt (Figure 8). No nesting sites are listed in TurtleNet for the Study area (TurtleNet, 2024) (Figure 8).

Loggerhead turtles have also been captured and tagged in the Groote Eylandt region, although this species is not known to nest in the area. Field survey activities undertaken in June 2024 sighted one loggerhead turtle within the Study area near the current tugboat day mooring (Appendix E).

The leatherback turtle may also be present in the vicinity of Groote Eylandt and is often recorded in the Gulf of Carpentaria; however, no known nesting occurs in the area (Limpus and Chatto 2004).

Suitable habitat, consisting of low energy coastal waters where seagrasses are widely available, support foraging for populations of green turtles, flatback turtles and hawksbill turtles occur further afield within the broader Study area (10 km radius). Habitat presence within the construction footprint and Project area is detailed in Section 5.3.3.

There is also a notable absence of turtle records in OBIS-Seamap within and surrounding the Study area (Figure 6 to Figure 9), but it is not clear whether this is because of low turtle density or lack of survey effort. Of the green turtles tagged on nesting beaches by Uldyower et al., 2023, none were tracked to the Study area (Figure 9).

Stakeholder engagement by GEMCO representatives with Bara and Jaragba Traditional Owners on 24 October 2023 corroborate the former, suggesting low densities of foraging turtles within the Port Limit.

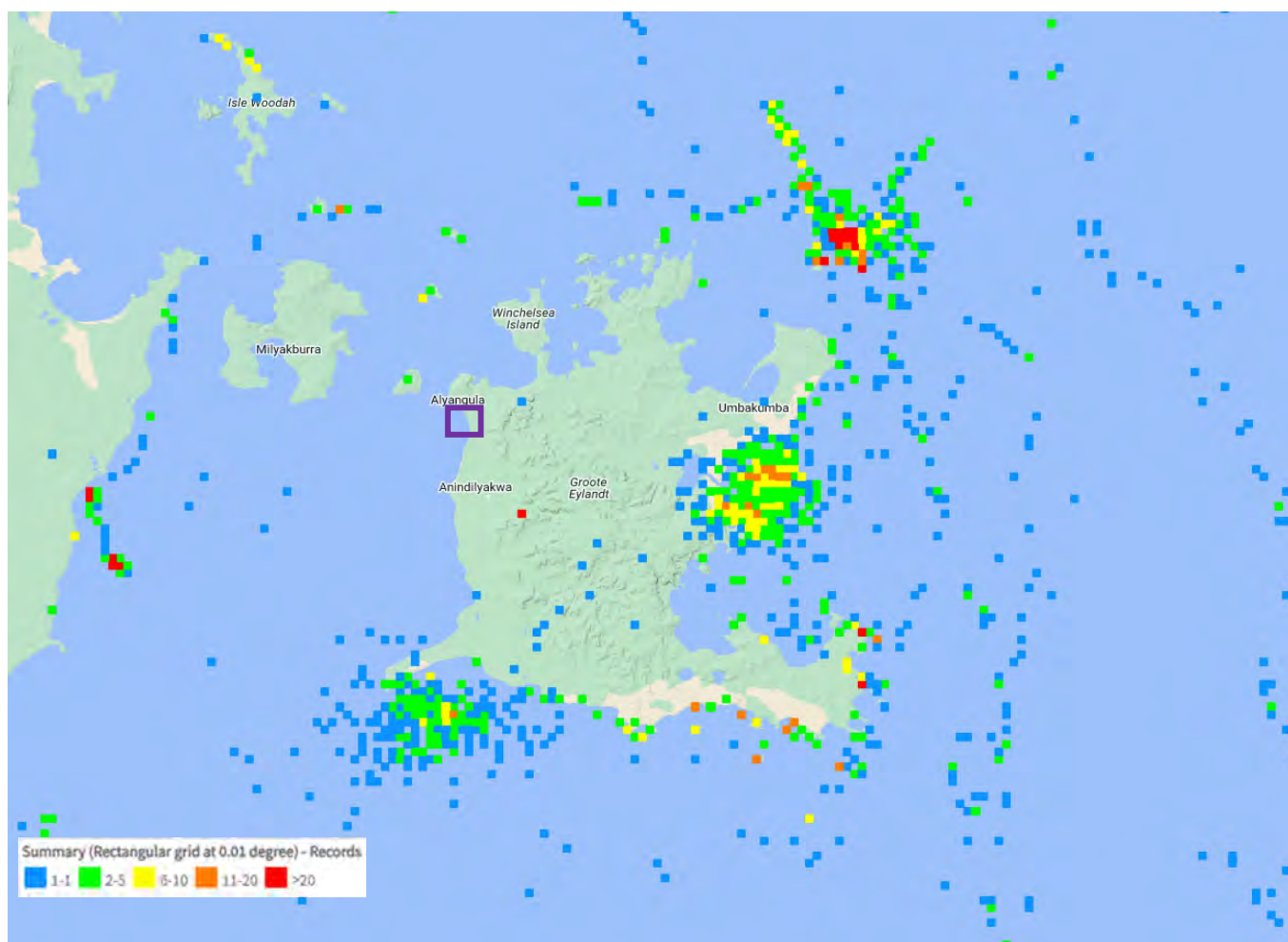


Figure 6 Marine turtle occurrence records around Groote Eylandt. Sourced from OBIS – Seemap (Halpin et al., 2009) (grid resolution 0.01)). Approximate Survey area shown by purple box.

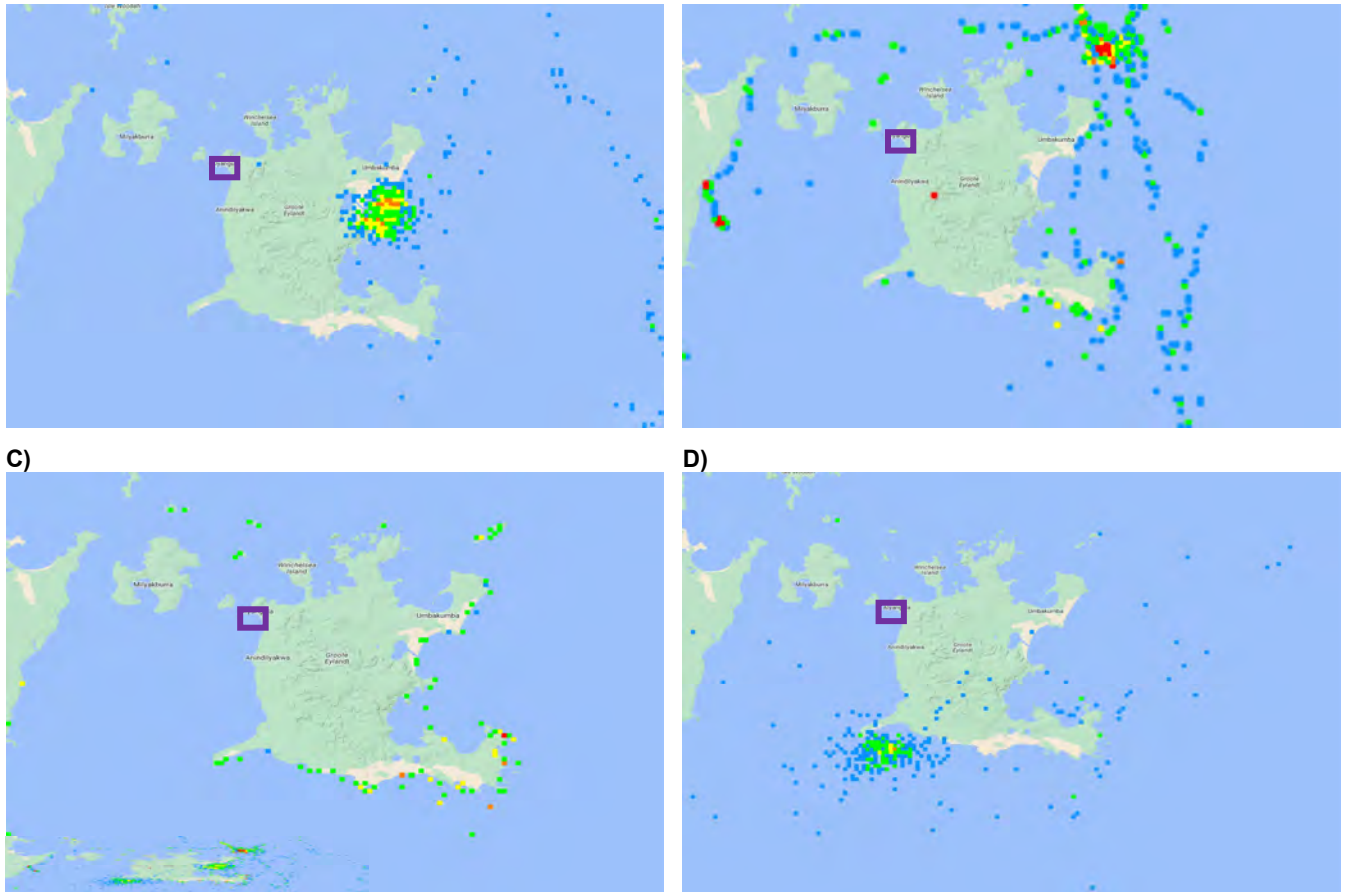


Figure 7 Species occurrence records around Groote Eylandt (sourced from OBIS – Seamap (grid resolution 0.01)) for four marine turtle species, including: A) flatback turtle, B) hawksbill turtle; C) green turtle; and D) olive ridley. (Noting no occurrence records for leatherback turtles or loggerhead turtles). Approximate Survey area shown by purple box.



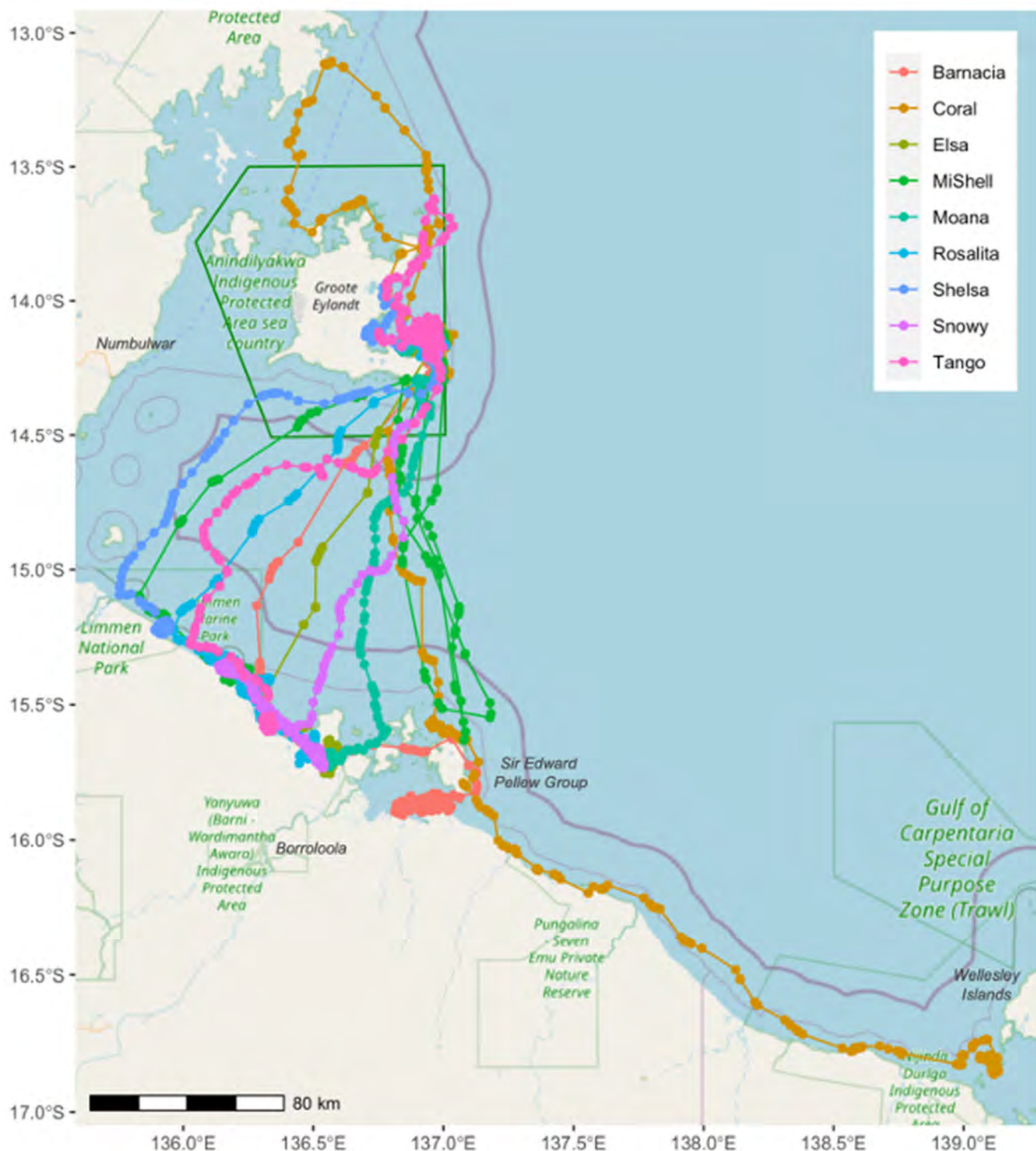


Figure 9 Satellite tracks of nine satellite tagged green turtles at Amjakikba Beach in October 2021 (Uldyawer et al., 2023)

5.1.3.2 Cetaceans and Sirenians

Recent studies suggest the presence of a resident population of the false killer whale (*Pseudorca crassidens*) (EPBC listed Cetacean, Not Threatened) in the Gulf of Carpentaria, with two individuals satellite tracked through the Study area (Palmer et al. 2023) (Figure 11). Dwarf spinner dolphins (*Stenella longirostris rosiventris*) (EPBC listed Cetacean, Not Threatened), while primarily a pelagic species that is also neritic, occurring in shallow coastal tropical and sub-tropical waters, have been confirmed near the southern coast of Groote Eylandt (NT government aerial surveys in 2014) (Allen 2021).

The dugong (*Dugong dugon*) (EPBC listed marine and migratory, Not Threatened) is one of only four living species of the order Sirenia, with a significant proportion of the world's dugong populations occurring in the North Marine Region. An aerial survey in 2007 identified almost 40% of dugongs sighted in waters adjacent to the NT coast of the Gulf of Carpentaria were in the Commonwealth waters of the North Marine Region (Marsh et al. 2008). Stakeholder engagement by GEMCO representatives with Bara and Jaragba Traditional Owners on 24 October 2023 identified that dugongs are not seen within the Port limits but are commonly observed around Winchelsea Island.

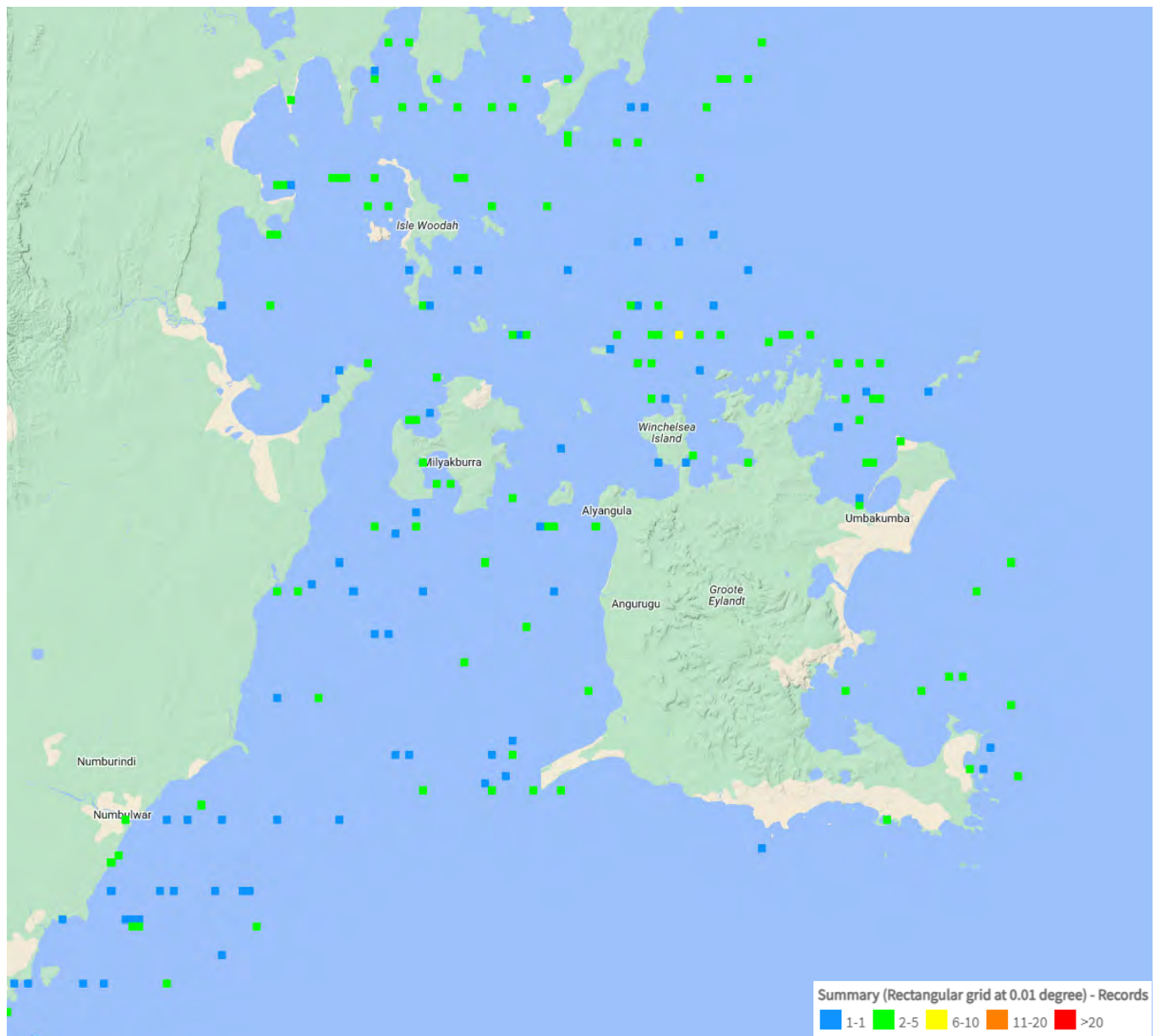


Figure 10 Cetacean sightings around Groote Eylandt (OBIS, 2024)

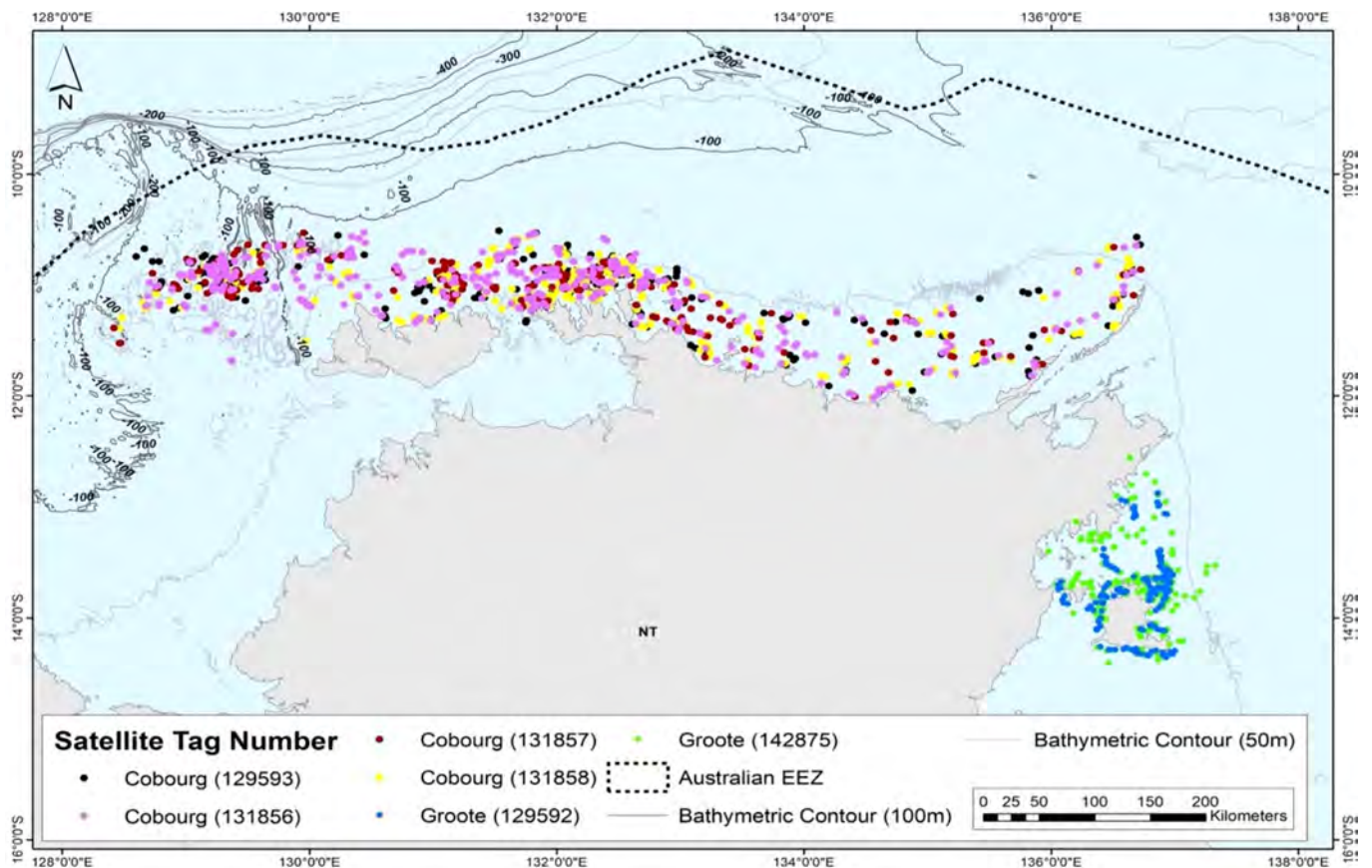


Figure 11 False killer whales satellite tracked in the region (Palmer et al., 2023)

5.1.3.3 Syngnathids and Solenostomids

The Syngnathidae family (EPBC listed marine, Not Threatened) includes seadragons, seahorses, pipehorses and pipefishes, and the Solenostomidae family includes the ghost pipefish; all are slow-moving fishes encased in bony “armour” made up of segmented rings and ridges. Twenty-eight syngnathid species and two solenostomid species are known to occur in the North Marine Region, with an additional 35 species infrequently occurring in the region.

Typically, syngnathids exhibit a preference for complex habitats (seagrass, macroalgal beds, coral reefs, mangroves, and sponge gardens) (Foster & Vincent 2004; Lourie *et al.* 2004; Scales 2010). Habitat can often be patchy, and as such, species distributions can be naturally fragmented (CITES, 2001) with a high affinity for microhabitat preferences due to limited swimming capabilities. Suitable habitat for these species is present within the Study area and Project area.

5.1.3.4 Sea snakes

Nineteen sea snake species are confirmed to occur within the North Marine Region and a further nine species identified as potentially occurring in the region (of the 35 species known to Australian waters (including sea kraits)). All sea snakes are listed under section 248 of the EPBC Act as protected marine species. Most information pertaining to sea snakes in the North Marine Region arises from trawler bycatch, with detailed information limited to six species.

Common sea snake species for the region (as indicated via Northern Prawn Fishery bycatch) include the olive-headed seasnake (*Disteira major*), elegant seasnake (*Hydrophis elegans*), ornate sea snake (*Hydrophis ornatus*) and spine-bellied sea snake (*Lapemis curtus*) (Fry et al. 2001). Suitable habitat for these species is present within the Study area and Project area and includes sand or mud substrates in marine and estuarine environments in water depths ranging from 2-80 m (DCCEEW, 2024). Breeding for the above species generally occurs in summer; whereas another common species, the spine-tailed sea snake (*Aipysurus eydouxii*) breeds during winter months.

5.1.3.5 Estuarine Crocodile

The estuarine (or saltwater) crocodile (*Crocodylus porosus*) has a tropical distribution along the northern coastline of Australia and occupies a range of habitats including coastal waters, estuaries, freshwater lakes, inland swamps, marshes, offshore islands and oceanic environments (Webb et al. 1987). The saltwater crocodile is listed under section 248 of the EPBC Act as a protected migratory and marine species.

In the NT, saltwater crocodile courtship begins 4-6 weeks before nesting and continues throughout the nesting period. Nesting correlates with the wet season, beginning in November and continuing until May, with peak nesting during January and February (Webb & Manolis 1989). Preferred nesting habitat includes elevated, isolated freshwater swamps that do not have the influence of tidal movements (Webb et al. 1987).

Estuarine crocodiles are known to occur in waters around Groote Eylandt, and the Study area is considered to be suitable foraging habitat for the species.

5.1.4 Biosecurity matters

Marine pests are non-indigenous aquatic flora or fauna species capable of establishing in a new area and can subsequently pose a significant threat to the environment and ecosystem functioning. Marine pests are commonly spread via vessel movement, either attached to ships or in ballast waters, or through changing coastal processes such as strengthening currents and altered water quality.

Four marine pests, Asian green mussel (*Perna viridis*), black-striped mussel (*Mytilopsis sallei*), American slipper limpet (*Crepidula fornicata*), and the charru mussel (*Mytella strigata*) have previously been identified as potential marine pest species in NT waters. However, only the Asian green mussel and the black striped mussel have had previous infestations recorded with the NT (DAFF, 2015).

Although not currently identified by the Federal Department of Agriculture, Fisheries and Forestry (DAFF) as a pest species in the region, the NT Government identifies the Asian bag mussel (*Arcuatula senhousia*) as a marine pest.

The Asian green mussel was first introduced to Australia in the early 1980s and has been detected in Darwin eleven times from 1999 – 2013. There is also one record of its occurrence in Darwin Harbour on the Ocean Biodiversity Information System (OBIS). More recently, Department of Agriculture and Fisheries (DAF) reported a detection of *P. viridus* on a vessel originating from Weipa (DAF, 2024).

The black-striped mussel was first detected in Darwin Harbour during 1989-1999; although, eradication efforts were successful, and no further infestation has been recorded. The American slipper limpet and charru mussel have not been recorded in Australia to date, however both species remain listed as a potential pest species of concern due to an increasing global distribution.

5.2 Baseline monitoring and historical surveys

5.2.1 Marine water quality

A marine environmental survey in Milner Bay was completed by Australian Marine Science Institute (AIMS) in December 2012 and included marine water sampling and analysis (Trott, 2012). Surveys were undertaken in proximity to the Port, to the north of the proposed construction footprint and far-field control sites and is used to understand historic water quality. However, this survey represents a single time point, and no temporal variability was included in the AIMS assessment. The following presents an overview of the main survey results.

Manganese concentrations were elevated in both filtered and unfiltered marine samples close to the Port relative to control sites further afield. Although manganese concentrations were elevated, they remained below the ANZECC/ARMCANZ (2000) water quality guideline level. Furthermore, no metal/metalloid analytes in marine water samples exceeded the relevant ANZECC/ARMCANZ (2000) guidelines.

Hydrocarbon concentrations were present in all marine water (and groundwater) samples, albeit at trace concentrations. Polycyclic aromatic hydrocarbon (PAH) concentrations were higher in marine water samples than either marine sediment or groundwater samples.

The PAHs found to be present in the 2012 marine water samples were thought to have originated from contaminated surface water runoff, submarine groundwater discharge or the sewage outfall discharge point located mid-way along the ship-loader jetty (Trott, 2012). Additionally, a diesel spill was known to have occurred in the Port prior to the AIMS survey, although the date of occurrence of this event was not stated in the report.

Since the AIMS survey, marine water quality has been sampled annually from 2013 under GEMCO's Marine Environmental Monitoring Program (MEMP). Monitoring has been conducted at eight control sites and 12 sites in vicinity of the Port; sampling has been completed at approximately the same time every year (during neap tides of October – December). A summary of in-situ marine water quality recorded during the GEMCO MEMP is provided in Table 8; Table 9 provides a summary of laboratory water quality analysis from the MEMP.

In 2023, recommended benchmark values were developed for the proposed marine discharge water quality by IndoPacific Environmental (IPE) (IPE, 2023), as shown in Table 8 and Table 9.



Figure 12 Water and sediment quality survey points from GEMCO MEMP (Image Source: Google Earth, 2024)

Table 8 *Summary of in-situ physiochemical parameters recorded during the GEMCO MEMP from 2013-2023*

	Turbidity (NTU)	Temperature (°C)	Redox (mV)	pH	Electrical conductivity (µS/cm)	DO (mg/L)	DO (% sat)
Recommended benchmark value (IPE, 2023)	20			7.65 (lower limit)			
Minimum	0.0	25.5	58	6.64	55	5.09	81.5
20 th percentile	2.5	28.3	87	7.59	55,445	6.24	96.5
Mean	4.4	30.0	160	7.87	66,596	6.61	99.4
Median	3.6	30.5	150	8.00	56,011	6.49	101.1
80 th percentile	5.4	31.1	244	8.07	93,150	7.16	102.3
Maximum	57.7	35.5	353	8.20	100,821	8.17	107.2
Number of records	259	303	263	303	114	113	76

Exceedances of benchmark values recommended by IPE highlighted in light blue.

Table 9 Summary of laboratory analyte concentrations recorded during the GEMCO MEMP from 2013-2023

Analyte*	Recommended benchmark value (µg/L) (IPE, 2023)	Number of samples	Detections above Limit of Reporting (LOR)	Minimum	20 th percentile	Mean	80 th percentile	95 th percentile	Maximum
Nutrients									
Units	mg/L			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Phosphorus	ne	432	125	0.02	0.03	0.19	0.10	0.60	9.84
Total Nitrogen	ne	66	7	0.05	0.25	0.33	0.50	0.60	1.30
Total Kjeldahl Nitrogen	ne	66	7	0.10	0.25	0.34	0.50	0.60	1.30
NOx	ne	42	3	0.005	0.005	0.010	0.017	0.025	0.070
Nitrate + Nitrate	ne	24	4	0.005	0.005	0.009	0.005	0.030	0.040
Metals									
Units	µg/L			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Aluminium	24	179	20	2.50	2.50	2.50	2.50	22.0	87.00
Antimony	270	13	0	0.25	0.25	0.25	0.25	0.25	0.25
Arsenic	12	171	171	0.60	1.30	1.50	1.80	2.15	2.50
Barium	-	179	179	4.00	6.00	7.00	7.00	8.00	12.00
Boron	-	164	164	2780	3820	4180	4630	4905	5110
Cadmium	0.7	171	0	0.05	0.10	0.10	0.10	0.10	0.10
Chromium	4.4	171	0	0.25	0.25	0.25	0.25	0.25	0.25
Cobalt	1	144	12	0.05	0.10	0.10	0.10	0.20	0.30
Copper	1.3	171	8	0.50	0.50	0.50	0.50	0.50	3.00
Iron	5.4	179	42	2.5	2.50	2.50	5.40	31.00	72.00
Manganese	300	187	170	0.25	1.00	1.80	4.20	7.01	10.90
Molybdenum	-	48	48	8.90	9.80	10.40	10.90	11.17	11.80
Nickel	6	171	15	0.25	0.25	0.25	0.25	1.00	1.40
Silver	1.4	48	0	0.05	0.05	0.05	0.05	0.05	0.05
Strontium		40	40	6950	7400	7660	8466	8662	8760

Analyte*	Recommended benchmark value (µg/L) (IPE, 2023)	Number of samples	Detections above Limit of Reporting (LOR)	Minimum	20 th percentile	Mean	80 th percentile	95 th percentile	Maximum
Metals									
Units	µg/L			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Tin	10	13	1	2.50	2.50	2.50	2.50	6.30	12.00
Zinc	8	187	2	2.50	2.50	2.50	2.50	2.50	7.00
>C10-C40 Fraction	0	187	3	50	50	50	50	50	780
Suspended solids	-	187	136	0.5	2	3	7	32.1	48

Exceedances of benchmark values recommended by IPE highlighted in light blue.

ne - not established

* a multiplier of 0.5 has been used for values below the LOR

5.2.1.1 Water quality (June 2024)

Physiochemical parameters

In situ water quality monitoring was conducted by GHD for 11 sites across the Project area (Figure 13) on 9 June 2024 (Appendix E). In situ sampling was undertaken at the water quality and sediment quality sampling locations (I1 – I5 and C1 – C6, respectively; Appendix E) adjacent the marine footprint (Figure 13). General observations from in-situ parameters measured are as follows:

- Water temperature was consistent across all monitoring locations with an average of 24.6 °C. This was below the long-term average of 30.0 °C (Table 8).
- Dissolved oxygen was consistent across all monitoring locations with an average of 100.2 % saturation and 7.17 mg/L, consistent with the long-term average of 99.4 % (Table 8).
- Conductivity remained consistent between all monitoring sites with an average of 41,717 µS/cm, lower than the long-term average of 66,596 µS/cm (Table 8).
- Trends in pH were consistent across all monitoring locations with an average of 8.07 pH units. This is consistent with the long-term average of 7.87 pH (Table 8).
- Turbidity (recorded at the surface) was consistent across all monitoring sites with an average of 2.52 NTU. This is below the long-term average of 4.4 NTU (Table 8).

Nutrients

Lab analysis for nutrient concentrations (Appendix E) are summarised as follows:

- Ammonia (as N) was detected in all samples, ranging between 0.08 - 0.16 mg/L, with an average and median concentration of 0.1 mg/L.
- Nitrate (as N) had one detection at 5.21 mg/L. This was above the long-term average of 0.01 mg/L (Table 9).
- Nitrogen (total oxidised) had one detection at 5.21 mg/L.
- Total nitrogen (Total N) had one detection at 5.2 mg/L. This was above the long-term average of 0.33 mg/L (Table 9).
- Total phosphorous (Total P) had one detection at 0.07 mg/L. This was below the long-term average of 0.19 mg/L (Table 9).
- Reactive phosphorous (as P), nitrite (as N) and Total Kjeldahl Nitrogen (TKN) were not detected in any samples.

Metals

Lab analysis for metal concentrations (Appendix E) was undertaken however matrix interference was encountered during the laboratory analyses for all metals resulting in samples requiring lab dilution with their LORs subsequently increased by the lab (referred to as adjusted LORs); this increase was above the trace concentrations historically recorded in the MEMP.

All samples from this monitoring event returned values less than the adjusted LOR, indicating that metal concentrations are not present in highly elevated concentrations above the adjusted LORs. A comparison to the long-term baseline dataset and recommended benchmark values (Table 9) is however, not considered appropriate due to the adjusted LORs.

Additional contaminants

Water samples were also tested for additional contaminants (Appendix E), namely:

- BTEXN / volatile organic compounds (VOCs): benzene, toluene, ethylbenzene, xylenes and naphthalene
- Total recoverable hydrocarbons (TRH)
- Polycyclic aromatic hydrocarbons (PAHs)
- Phenols (halogenated and non-halogenated)
- Organochlorine (OC) and organophosphate (OP) pesticides
- Polychlorinated biphenyls (PCBs)

Of these additional analytes, no detections were observed above their respective LORs.



5.2.2 Discharge water quality

To maintain compliance with GEMCO's MMP and ensure dewatering activities do not cause significant environmental impacts, GEMCO undertakes monitoring of source water quality before discharge to land for comparison to a range of trigger values.

A review of historical discharge water quality was completed by IndoPacific Environmental (IPE) with water quality data from 2008 – 2023 collated, reviewed, and summarised to understand parameters that may be of relevance when discharging to the marine environment (IPE, 2023). 148 analytes were assessed, however many of these were analysed infrequently. Parameters were discounted where available information indicated all available concentrations were below the laboratory limit of reporting (LOR).

Historical source water is consistently relatively fresh (3,780 $\mu\text{S}/\text{cm}$), mildly to moderately acidic (median pH 5.7) with a median turbidity of 5.5 NTU (IPE, 2023). Nutrient concentrations in the discharge water were variable; total nitrogen and nitrate have median values of 215 and 211 $\mu\text{g}/\text{L}$, respectively, while phosphorus and phosphate median concentrations are generally below the laboratory LOR.

Manganese concentrations in discharge water are commonly detected above the laboratory's LOR, with median manganese concentration calculated as 51 $\mu\text{g}/\text{L}$, although significantly higher concentrations were recorded in the dataset (maximum value 8,020 $\mu\text{g}/\text{L}$). Additionally, strontium, barium, aluminium, rubidium, lithium, zinc, and nickel, were all detected in discharging water quality, although at decreasing frequencies respectively. Other metals and metalloids were infrequently above the analysing laboratory's LOR, although elevated concentrations were present. Summary statistics for metals and metalloids in discharge water is presented in Table 10.

Rare-earth elements were not often detected in quarry water, with most concentrations for rare-earth elements below the LOR. Lanthanide series (15 consecutive chemical elements in the periodic table from lanthanum to lutetium) and yttrium were identified infrequently at concentrations above the analysing laboratory's LOR.

Total petroleum hydrocarbons (>C10 – C40) are not frequently detected in quarry water and are not authorised to be discharged.

Table 10 *Summary statistics for metals and metalloids in discharge water quality including, frequency of detection, minimum, median and maximum concentrations*

	Aluminium	Antimony	Arsenic	Barium	Boron	Cadmium	Caesium	Chromium	Cobalt	Copper	Iron	Lithium	Manganese	Molybdenum	Nickel	Rubidium	Silver	Strontium	Tin	Titanium	Zinc
Detection frequency	31%	1%	1%	76%	7%	2%	4%	3%	3%	7%	4%	18%	100%	4%	15%	28%	1%	98%	2%	3%	16%
Minimum (µg/L)	5	0.5	0.5	0.5	25	0.05	0.5	0.5	0.5	0.5	25	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	5	2.5
Median (µg/L)	5	0.5	0.5	2	25	0.05	0.5	0.5	0.5	0.5	25	0.5	51	0.5	0.5	0.5	0.5	10	0.5	5	2.5
Maximum (µg/L)	2,920	2	5	121	170	0.2	8	2	5	10	1,040	17	8,020	3	13	8	2	285	3	70	196

5.2.3 Sediment quality

The Marine Environmental Survey in Milner Bay (Trott, 2012) also included marine sediment sampling. Surveys were undertaken in proximity to the Port, to the north of the proposed Construction footprint and far-field control sites and is used here to understand historic marine sediment quality. However, the AIMS survey represents a single time point, and no temporal variability was included in the AIMS assessment.

Several total metals and total metalloids (manganese (Mn), zinc (Zn), cobalt (Co), copper (Cu) and lead (Pb)) had elevated concentrations in offshore marine and beach sediment samples near the Port, with concentrations diminishing rapidly with distance away from the Port. Some metal and metalloid concentrations exceeded the ANZECC sediment quality guideline levels at sites close to the Port, with potentially bio-available concentrations of copper, lead and zinc in offshore and beach sediments. As such, Trott (2012) suggested a moderate to high level of risk of adverse ecosystem impacts, although impacts are not expected to have been extensive, primarily due to the limited solubility of these analytes and their ready adsorption to sediment particles.

Trott (2012) further reported that total petroleum hydrocarbons concentrations in all marine sediments were marginal, at or marginally above the limit of detection irrespective of location (control vs. port sites). Concentrations of PAH were below the LOR for all control sites, with trace concentrations in marine sediments near the Port facility. All PAH concentrations in marine sediments were below the Interim Sediment Quality Guidelines for PAHs (ANZECC 2000).

GEMCO have also undertaken sediment quality assessment within the MEMP since 2013, focusing primarily on metals analysis. Analytes with greater than 100 detections over the 10 years are summarised below and detailed in Table 11:

- Aluminium had 818 detections with a minimum detected concentration of 480 mg/kg, maximum of 24,500 mg/kg and a median of 1,175 mg/kg. The 20th and 80th percentile concentrations were 612 mg/kg and 2,834 mg/kg, respectively.
- Arsenic had 595 detections with a minimum concentration of <1 mg/kg, a maximum of 49 mg/kg and a median of 5.6 mg/kg. The 20th and 80th percentile concentrations were 2.5 mg/kg and 10 mg/kg, respectively, which are below the ANZG DGV of 20 mg/kg.
- Barium had 675 detections with a minimum concentration of <1 mg/kg, a maximum of 2,440 mg/kg and a median of 7 mg/kg. The 20th and 80th percentile concentrations were 5 mg/kg and 20 mg/kg, respectively.
- Boron had 103 detections with a minimum concentration of <1 mg/kg, a maximum of 70 mg/kg and a median of 19 mg/kg. The 20th and 80th percentile concentrations were 3 mg/kg and 28.2 mg/kg, respectively.
- Chromium had 704 detections with a minimum concentration of <1 mg/kg, a maximum of 113 mg/kg and a median of 6 mg/kg. The 20th and 80th percentile concentrations were 2 mg/kg and 13 mg/kg, respectively.
- Cobalt had 351 detections with a minimum concentration of <0.5 mg/kg, a maximum of 27 mg/kg and a median of 2 mg/kg. The 20th and 80th percentile concentrations were 0.8 mg/kg and 4 mg/kg, respectively.
- Copper had 151 detections with a minimum concentration of <1 mg/kg, a maximum of 16 mg/kg and median of 2.5 mg/kg. The 20th and 80th percentile concentrations were 1.4 mg/kg and 7 mg/kg, respectively. All concentrations of copper reported throughout the program were below the ANZG DGV of 65 mg/kg.
- Iron had 850 detections with a minimum concentration of 120 mg/kg, a maximum of 64,300 mg/kg and a median of 2,935 mg/kg. The 20th and 80th percentile concentrations were 808 mg/kg and 8,018 mg/kg, respectively.
- Lead had 427 detections with a minimum concentration of <1 mg/kg, a maximum of 29 mg/kg and a median of 5.4 mg/kg. The 20th and 80th percentile concentrations were 6 mg/kg and 9 mg/kg, respectively. All concentrations of lead reported throughout the program were below the ANZG DGV of 50 mg/kg.
- Manganese had 850 detections with a minimum concentration of 54 mg/kg, a maximum of 104,000 mg/kg and a median of 590.5 mg/kg. The 20th and 80th percentile concentrations were 204.8 mg/kg and 2,016 mg/kg, respectively.
- Nickel had 334 detections with a minimum concentration of <1 mg/kg, a maximum of 29 mg/kg and a median concentration of 3 mg/kg. The 20th and 80th percentile concentrations were 1.5 mg/kg and 6 mg/kg, respectively, which are below the ANZG DGV of 21 mg/kg.

- Strontium had 744 detections with a minimum concentration of 31 mg/kg, a maximum of 4,220 mg/kg and a median of 837 mg/kg. The 20th and 80th percentile concentrations were 124.6 mg/kg and 2,060 mg/kg, respectively.
- Vanadium had 730 detections with a minimum concentration of <2 mg/kg, a maximum of 139 mg/kg and a median of 11 mg/kg. The 20th and 80th percentile concentrations were 3.8 mg/kg and 26 mg/kg, respectively.
- Zinc had 552 detections with a minimum concentration of <1 mg/kg, a maximum of 202 mg/kg and a median of 6 mg/kg. The 20th and 80th percentile concentrations were 2.1 mg/kg and 17 mg/kg, which are below the ANZG DGV of 200 mg/kg.

5.2.3.1 Sediment quality (June 2024)

Particle size distribution

In June 2024, GHD collected sediment samples at six sites in the vicinity of the marine footprint (C1 – C6, shown in Figure 13) for particle size analysis (Appendix E). Note that particle size distribution (PSD) data for site C3 is missing due to insufficient sample volume for both PSD analysis and ASS analysis. The particle size distributions were relatively similar across sites (Figure 14), with the following findings:

- Cobbles (>6 cm) were not detected within any samples.
- There were low levels of gravel (2 - 60 mm) detected across all sampled sites, ranging from 2 – 17%, with an average of 8.4%.
- Sand (0.06 – 2.00 mm) was present at all sites, ranging from 72 – 96%, with an average of 81%.
- Silt (2 – 60 µm) was present at all sites with the exception of C1 in low amounts, ranging from 1 – 5% with an average of 2.5%.
- Clay (<2 µm) was present at all sites, with a minimum and maximum percentage of 2% and an average and median concentration of 12%.

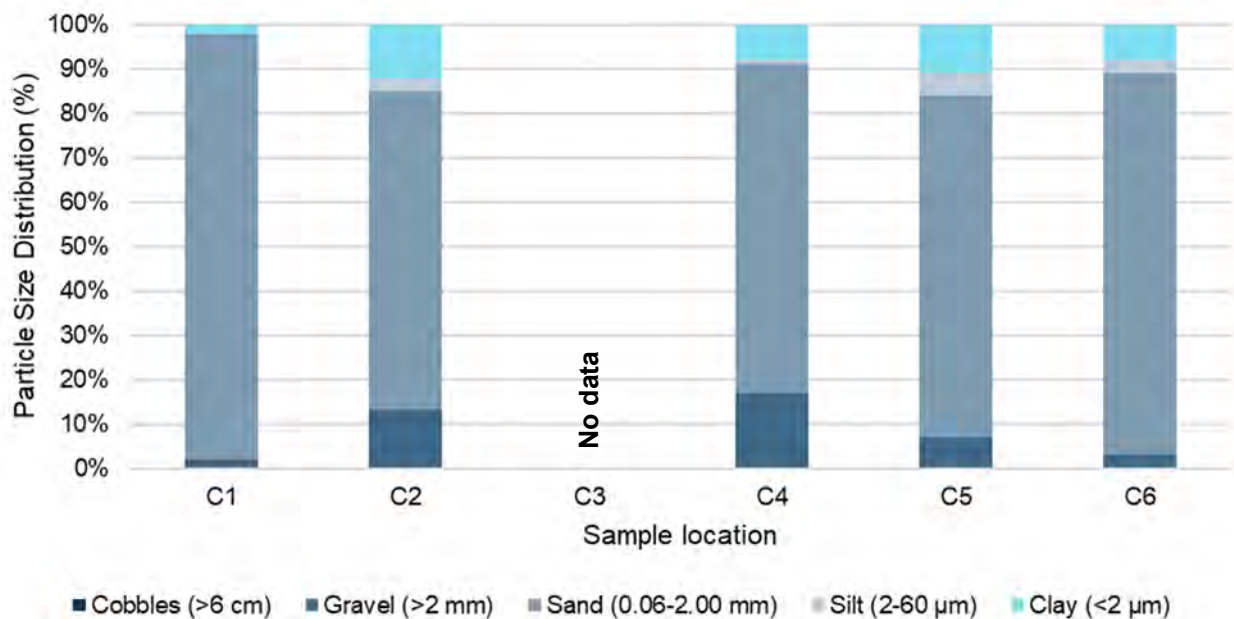


Figure 14 Summary particle size distribution results for sediment sampling in the vicinity of the marine footprint in June 2024

Nutrients

Sediment samples were collected at 10 sites (C1 – 6, and I1 – 4; Figure 13) and sent to the laboratory for nutrient analysis (Appendix E). Nutrients detected above the respective LOR are summarised as follows:

- Nitrate was detected in most samples, ranging between 0.2 – 4.2 mg/L, with an average concentration of 1.3 mg/kg.

- Total oxidised nitrogen was detected in most samples, ranging between 0.2 – 4.2 mg/kg, with an average concentration of 1.3 mg/kg.
- Total nitrogen was detected in most samples, ranging from 70 – 460 mg/kg, with an average concentration of 181 mg/kg.
- Total Kjeldahl Nitrogen was detected in most samples, ranging from 70 – 460 mg/kg, with an average concentration of 181 mg/kg.
- Phosphorous (Total) was detected in all samples, ranging from 62 – 241 mg/kg, with an average concentration of 128 mg/kg.
- Reactive phosphorus was detected in most samples, ranging from 0.2 – 0.4 mg/kg, with an average concentration of 0.17 mg/kg.

Samples also underwent analysis for ammonia and nitrite, but these analytes were not detected in any samples.

Metals

Sediment samples were laboratory tested for metals and metalloid concentrations (Appendix E). Overall, no elevated concentrations of metals in sediments were recorded. Those contaminants detected above the respective LOR are summarised as follows:

- Arsenic was detected in most samples, ranging from 6 – 14 mg/kg with an average concentration of 7.1 mg/kg.
- Chromium (III + VI) was detected in all samples, ranging from 6 – 22 mg/kg with an average concentration of 13 mg/kg.
- Nickel was detected in one sample at 3 mg/kg.
- Zinc was detected in two samples at 8 mg/kg and 9 mg/kg.

Samples also underwent analysis for cadmium, copper, lead and mercury, but these analytes were not detected in any samples.

Additional contaminants

Sediment samples were also tested for additional contaminants (benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEXN), total recoverable hydrocarbons (TRH), Phenols, organochloride (OC)/organophosphate (OP), polychlorinated biphenyls (PCBs) and PAHs; Appendix E). For these additional analytes, no detections were observed above their respective LORs.

Potential Acid Sulfate Soils

Surface sediment samples were also assessed against the potential acid sulfate soils (PASS) analytical suite (Appendix E) with the following findings:

- No actual acid sulfate soils (AASS) were present, only PASS.
- Excess acid neutralising capacity (ANC) was identified such that the sediment is considered to be self-neutralising.

Overall there is a low risk of contaminant mobilisation due to acidification, aligning with the conclusions of the GEMCO Tug Replacement Project (Indo-Pacific, 2022)

Table 11 Summary of sediment quality data recorded during the GEMCO MEMP from 2013-2023 showing only analytes where values were recorded above LOR (all values in mg/kg).

	Aluminium	Arsenic	Barium	Boron	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Strontium	Vanadium	Zinc
ANZG DGV	-	20	-	-	-	-	65	-	50	-	21	-	-	200
Minimum	480	<1	<1	<1	<1	<0.5	<1	120	<1	54	<1	31	<2.0	<1.0
20th Percentile	612	2.5	5	3	2	0.8	1.4	808	1.9	204.8	1.5	124.6	3.8	2.1
Mean	2,932	6.8	92	20.3	9.4	3.1	4.2	5414	6	3361.9	4.2	1,135	16.9	11.4
Median	1,175	5.6	7	19	6	2	2.5	2,935	5.4	590.5	3	837	11	6
80th Percentile	2,834	10	20	28.2	13	4	7	8,018	9	3,016	6	2,060	26	17
Maximum	24,500	49	2,440	70	113	27	16	64,300	29	104,000	29	4,220	139	202
Number of detects	818	595	675	103	704	351	151	850	427	850	334	744	730	552

5.2.4 Macroinvertebrates

Generally, marine invertebrates are poorly sampled and understood worldwide, this includes the Gulf of Carpentaria and Groote Eylandt. Abundant and diverse communities of polychaetes, crustaceans, molluscs, and echinoderms characterise the Gulf of Carpentaria basin (Long et al. 1995; Haywood et al. 2005). A total of 33 species have been recorded in the Gulf of Carpentaria, including representatives from the Platyhelminthes, Bryozoa, Arthropoda, Mollusca, Nematoda, Cnidaria and Chordata phyla. To support description of the macroinvertebrate communities of relevance to the Project, these have been split into benthic epifauna (living on the seabed) and benthic infauna (living in the sediment).

5.2.4.1 Benthic epifauna

During the video transects undertaken by WSP in late 2023, diversity, abundance and cover of epibiota communities were lower in deeper waters and higher in shallow subtidal areas, following a change in substrate from mud/silt in deeper waters to sand/gravel in shallower areas (WSP, 2023). Generally, sandy habitat was devoid of epifauna although hard structures scattered amongst sand supported corals and epifauna communities.

5.2.4.2 Benthic infauna

Bioturbation is the physical and chemical alteration of sediment by organisms and can be used to assess infauna communities, providing information on both the relative abundance and functional groups of infauna present (e.g., polychaete worms, crustaceans, molluscs and, fish).

No direct studies have been completed in the survey area; however, bioturbation viewed from WSP video transect surveys is used as a proxy. Extensive bioturbation was observed within the soft mud and silt habitat in subtidal depths; however, no species were directly observed by WSP during their surveys (WSP 2023), and fauna are conjectured to be those frequently found in soft mud and silt habitats.

Overall, the benthic infauna habitat observed within the Project area, and the marine footprint, is not considered to be unique or of high ecological value while representative infauna habitat is abundant throughout the broader Study area.

5.2.5 Marine species

As noted in Section 5.1.1, Groote Eylandt broadly contains a wide range of habitats that support a diverse range of fish species. However, benthic habitat surveys of the Project area show that these supportive habitats are largely absent (Section 5.3.1).

Benthic surveys completed by WSP in 2023 within and surrounding the Project area observed fish were generally in close proximity to clumps of epibiota or the coral reef structures however the surveys were not designed to assess species abundance and diversity in detail (WSP 2023).

Stakeholder engagement by GEMCO representatives with Bara and Jaragba Traditional Owners on 24 October 2023 identified that a 6 m estuarine crocodile resides within a creek south of the Project area (creek name not specified, assumed to be Malaga Creek; Figure 1). The Project area is not traditionally known as an important area for marine turtle species.

This report is largely concerned with MNES and NT TPWC Act listed threatened species likely to occur or confirmed to occur in the Project area. As such, conservation-specific species are reviewed in detail in Appendix B and Appendix C.

5.3 Marine habitat and baseline benthic surveys

Benthic habitat surveys were undertaken by WSP during summer (September 2023) (Appendix D) and GHD in winter (June 2024) (Appendix E). These surveys provide seasonal snapshots of the benthic habitat and understanding of temporal variation. The observations of these surveys are summarised in Sections 5.3.3.1 and 0 below. The area surveyed (Survey area) includes the Project area (i.e. the construction footprint and modelled mixing zone), as well as habitat to the north and south of the Project area.

Benthic habitats observed (detailed in Section 5.3.1 to Section 5.3.3) are summarised below and illustrated in Figure 16. These include:

- Open soft substrate in deeper waters beyond 15 m depth.
- Open sandy substrate in shallower areas from 15 m to intertidal zone.
- Hard substrate and reefs adjacent to the jetty (north and south) in the nearshore zone.
- Seagrass and macroalgae present in patches throughout the Survey area in summer, with particularly dense meadows approximately 200 m south of the marine footprint and extending beyond the southernmost survey boundary at approximately 800 m south of the marine footprint. However, in winter, seagrass and macroalgae were found to be entirely absent from the survey area, with the exception of a few individuals found in the nearshore (approximately 100 m from surf zone), approximately 310 m south of the marine footprint.
- Scattered coral gardens and individual coral colonies in pockets south of the marine footprint.

5.3.1 Soft substrate habitats

Generally, soft substrate (mud, sand, silt) dominated the Survey area. Mud and silt were extensively observed in the subtidal environment at depths greater than 15 m, with a fine layer of easily disturbed silt over the seabed (Figure 15; Figure 16). In approaching the shoreline (depths <10 m), the substrate changed to coarse sand with some gravels present while some pockets of rubble were also present throughout. Furthermore, this sandy substrate was present between hard substrates and intertidal zone. In shallow nearshore environments, the effects of wave action were visible in the form of sand ripples.

5.3.2 Hard substrate and coral reef

Boulders and small patch reef structures were observed within the shallow subtidal zone immediately adjacent the ship-loader jetty to the north and south (Figure 15; Figure 16). Hard substrate in the shallow subtidal was observed as supporting a diverse range of species, including corals, bryozoans, hydroids, ascidians and algae. Localised patches of coral gardens, consisting of rubble with individual coral colonies were also identified approximately 400-500 m south of the marine footprint.

5.3.3 Seagrass and macroalgae

A Marine Environmental Survey in Milner Bay was completed by AIMS in 2012 and included seagrass surveys, recording six species (*Cymodocea serrulata*, *Syringodium isoetifolium*, *Halodule uninervis*, *Halophila ovalis*, *Halophila spinulosa*, and *Halophila decipiens*) (Trott, 2012). Seagrass was absent north of the Port, while dense seagrass beds were recorded further afield during the AIMS 2012 survey, outside of Port limits in subtidal waters inshore of the reef habitats, between Malgala Creek (3.7 km south of the wharf) and Andungwa creek (6.5 km south of the wharf) (Figure 1). Epiphyte presence was generally low with no obvious grazing evidence by either turtles or dugongs.

As noted previously, two additional surveys were undertaken within the Survey area in September 2023 (WSP 2023) and June 2024 (GHD 2024). Summaries of these surveys are provided in Sections 5.3.3.1 and 0 below with the survey reports presented in Appendix D and Appendix E.

5.3.3.1 Summer survey (September 2023)

Overall, the WSP (2023) survey found habitats were largely consistent throughout the Survey area, with the exception of the reef structures which were predominantly present in closest proximity to the Milner Bay Port (Figure 15).

Key observations from the summer survey included:

- Extensive bioturbation within the soft mud and silt habitat in the subtidal depths.
- A gradual change in substrate from mud/silt in the deepest areas to gravelly sand closer to shore.
- Epibiota was present throughout the survey area and generally increased in cover, abundance and diversity from deeper to shallower zones. Epibiota was also densest and most common in areas of rubble and gravels on mud or sand.

- Seagrass was absent within the marine footprint and generally sparse within the survey area with the exception of some patches between 200-800 m south of the marine footprint. Density and spatial extent of seagrass patches increased near the southern-most extent of the survey area (Transect Q).
- An area of rocky reef with sections of macroalgae and coral was observed approximately 100-300 m north of the marine footprint in the nearshore zone between the ship-loader jetty and the marine footprint. Coral on rock communities were generally sparsely present throughout the survey area however more established coral gardens were observed approximately 450 m south of the marine footprint.

During the summer survey (September 2023), a small patch of sparse seagrass and macroalgae was observed along Transect G, approximately 100 m north of the marine footprint (Plate 1; Figure 16). No seagrass was observed within or adjacent to the marine footprint. South of the marine footprint, starting approximately 200 m south and extending beyond the survey area boundary approximately 800 m south, numerous areas of seagrass presence were observed (Plate 1 to Plate 4; Figure 16). Seagrass densities varied from individuals and sparse patches along the shallower extents of Transects J, N, L and O, to larger, denser and more spatially extensive patches near the boundary of the Survey area along Transects Q (Plate 4; Figure 15; Figure 16).

Macroalgae from the genus *Caulerpa* was also recorded during the summer survey, generally as monoculture patches. *Caulerpa* spp. was observed during the summer survey on a range of substrates at various depths, with cover ranging from sparse to complete cover (Figure 15; Plate 1 to Plate 4). The highest density occurred in shallow subtidal areas (<5 m) in the southern extremity of the Survey area.

A sparse patch of seagrass was observed in the Survey area during the WSP summer survey approximately 100 m north of the marine footprint during the summer survey, as shown in Plate 1. This was located along Transect I at 4 min 23 sec into the 12 minute dive time (according to image metadata) and therefore estimated to be approximately in an area near the western end of the marine footprint. This patch was not observed during the winter survey of the same transect.



Figure 15 Broad-scale benthic habitat in vicinity of proposed pipeline corridor during summer (extracted from WSP, 2023)

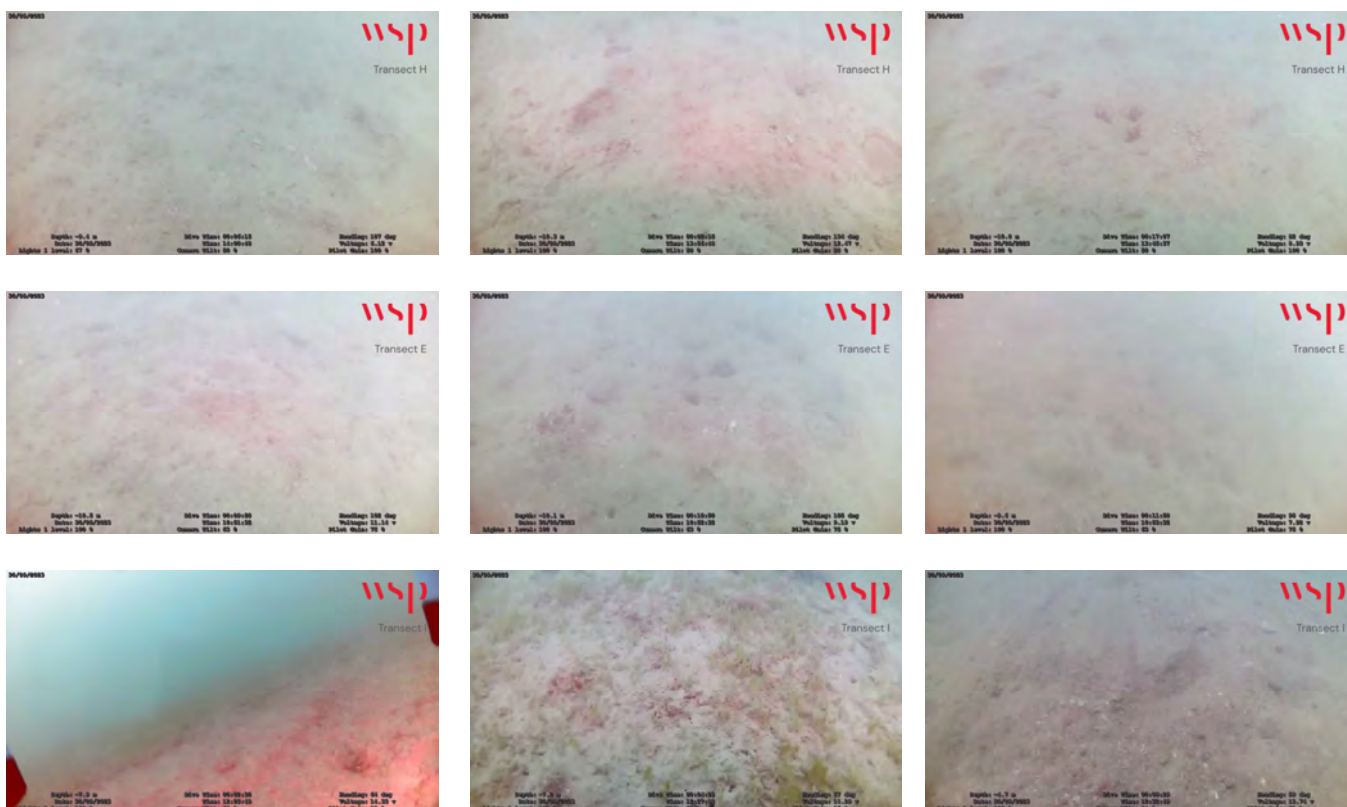


Plate 1 Representative benthic habitat within and adjacent to the marine footprint recorded during the summer (September 2023) survey. Transects H (top row), Transect E (middle row) and Transect I (bottom row). Noting seagrass presence along Transect I (bottom-center image).

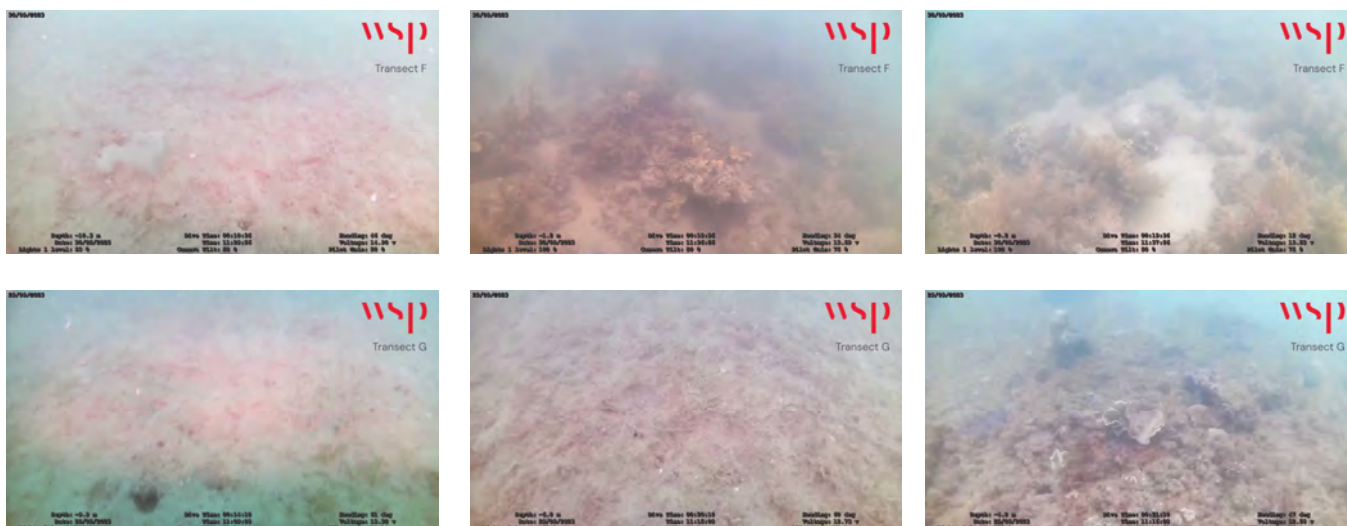


Plate 2 Representative benthic habitat north of the marine footprint recorded during the summer (September 2023) survey. Transect F (Top row), Transect G (bottom row)

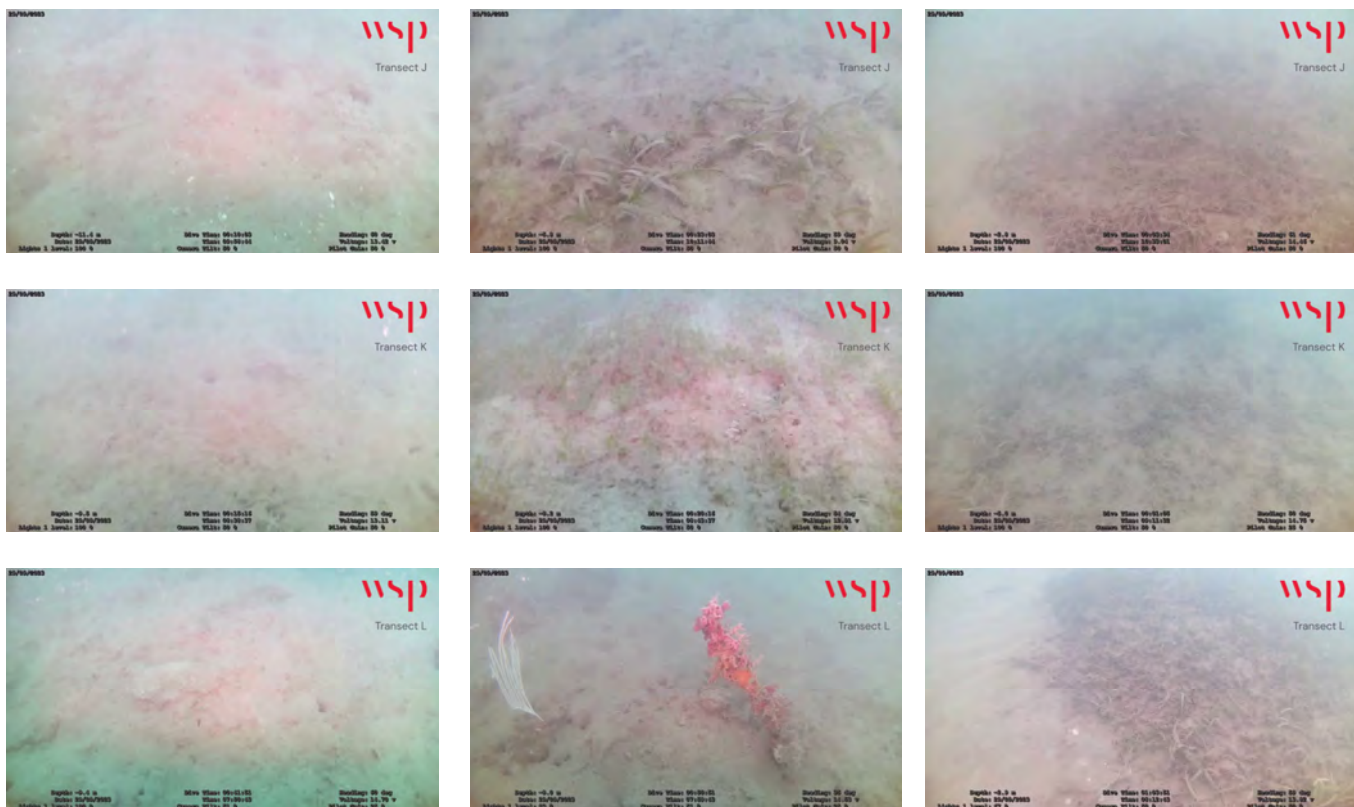


Plate 3 Representative benthic habitat south of the marine footprint recorded during the summer (September 2023) survey. Transects J (top row), Transect K (middle row) and Transect L (bottom row).

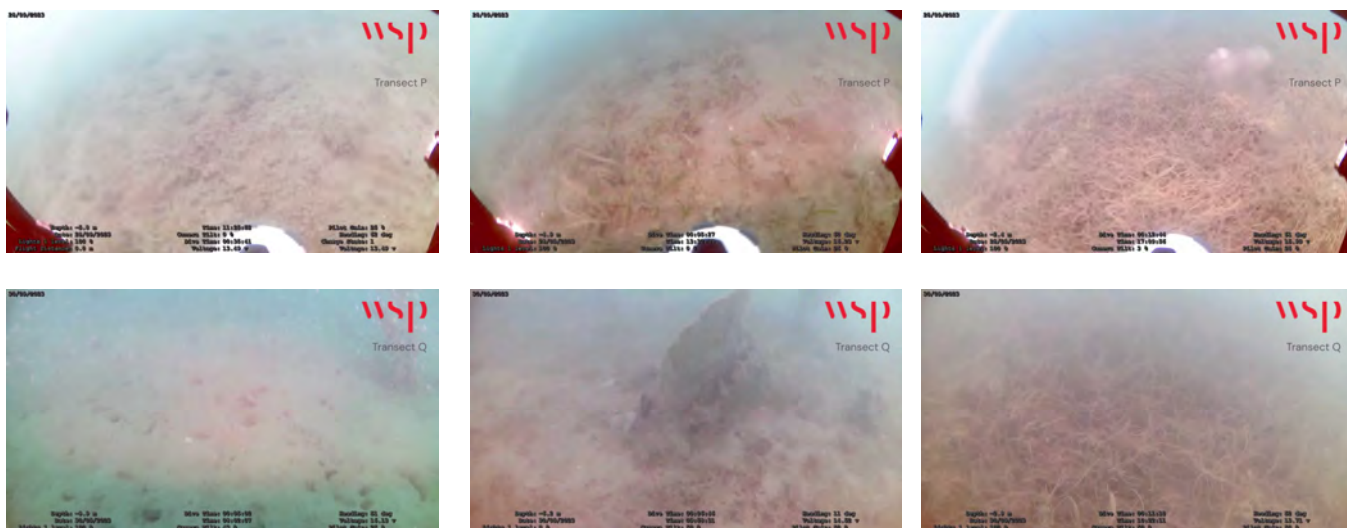


Plate 4 Representative benthic habitat to the far south of the marine footprint recorded during the summer (September 2023) survey. Transect P (Top row), Transect Q (bottom row)

Winter survey (June 2024)

A total of 17 transects were surveyed during the GHD 2024 winter survey (Figure 16). Overall, the seabed within the marine footprint was confirmed to consist of open sandy substrate, lacking high value habitat features. A small patch of macroalgae was observed on the northern boundary of the marine footprint. Habitat was also well represented throughout the Survey area. However, a small pocket of rocky reef with established coral colonies was identified in the nearshore area. This area was located approximately 130 m to the north of the marine footprint (Figure 16).

Areas south of the marine footprint (Plate 7; Plate 8) were observed to contain diverse patches of rocky coral gardens and benthic communities. These patches are located 500-560 m south of the footprint.

Observations during the winter surveys (June 2024) identified the Construction footprint was largely devoid of any seagrass or macroalgae (Plate 5 to Plate 8), with the exception of a few individual plants of *H. ovalis* identified where denser meadows had been located during summer (Figure 15; Figure 16; Appendix D; Appendix E).

Seagrass (*H. ovalis*) was observed along Transect N (Figure 16), approximately 310 m from the footprint, however this occurrence was limited to a few individual blades. Seagrasses were not observed during any other transects, contrasting with the observations of the summer 2023 surveys (Figure 16).

The broad absence of seagrass in the Survey area during the winter (June 2024) survey indicates that seagrasses within the Survey area are seasonally absent during winter and present during summer months. The variability in seagrass observed between the two surveys is consistent with existing literature on seagrasses in the Gulf of Carpentaria which identified that presence and distribution is highly variable and dependent on a suite of environmental factors including season (wet/dry), El Niño and La Niña events, decadal cycles of daytime tidal exposure, rainfall and flooding from local river systems (Carter *et al.*, 2023).

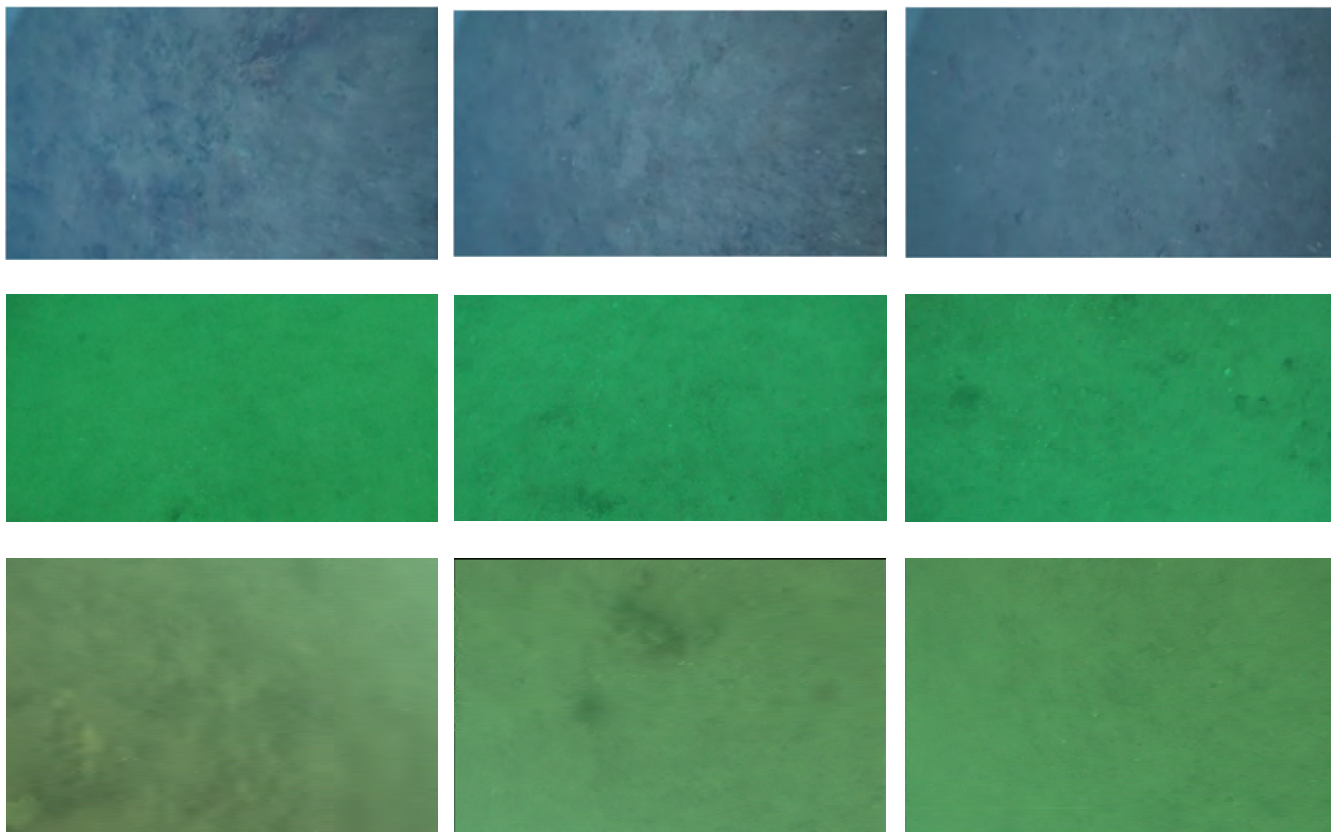


Plate 5 Representative benthic habitat within and adjacent to the marine footprint recorded during the winter (June 2024) survey. Transect H (Top row), Transect E (middle row), Transect I (bottom row)

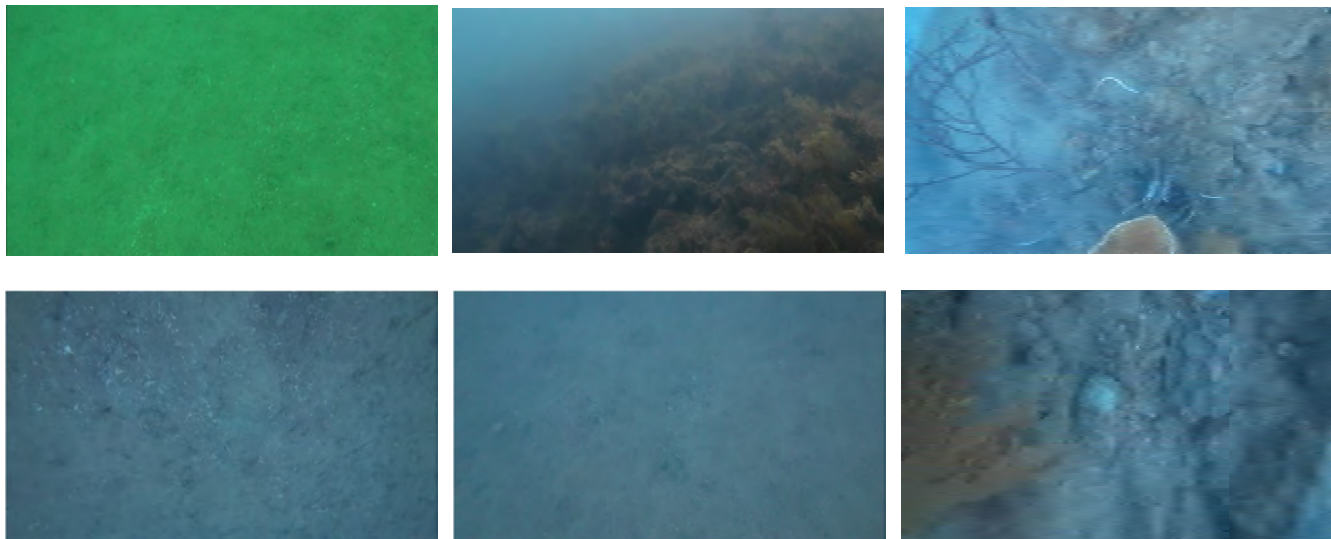


Plate 6 Representative benthic habitat north of the marine footprint recorded during the winter (June 2024) survey. Transect F (Top row), Transect G (bottom row)

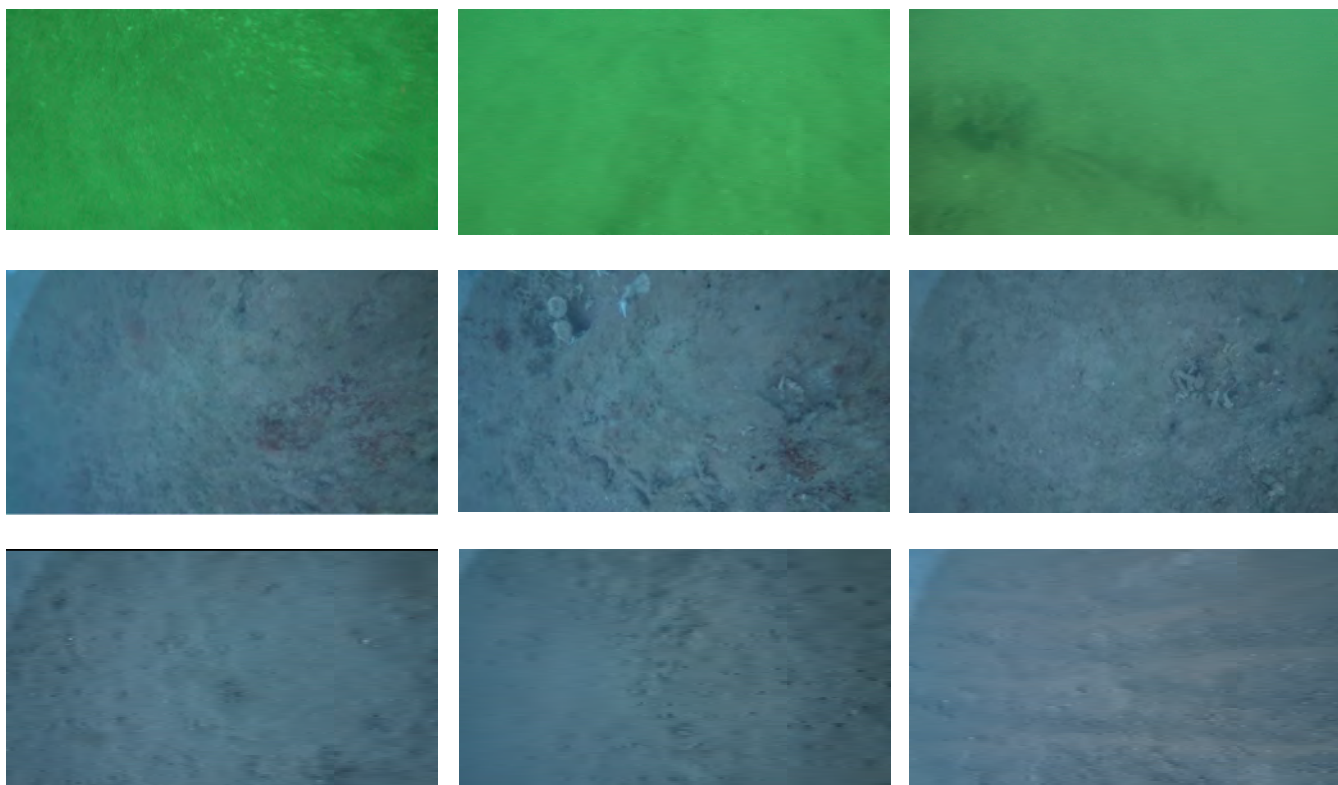


Plate 7 Representative benthic habitat south of the marine footprint recorded during the winter (June 2024) survey. Transects J (top row), Transect K (middle row) and Transect L (bottom row).

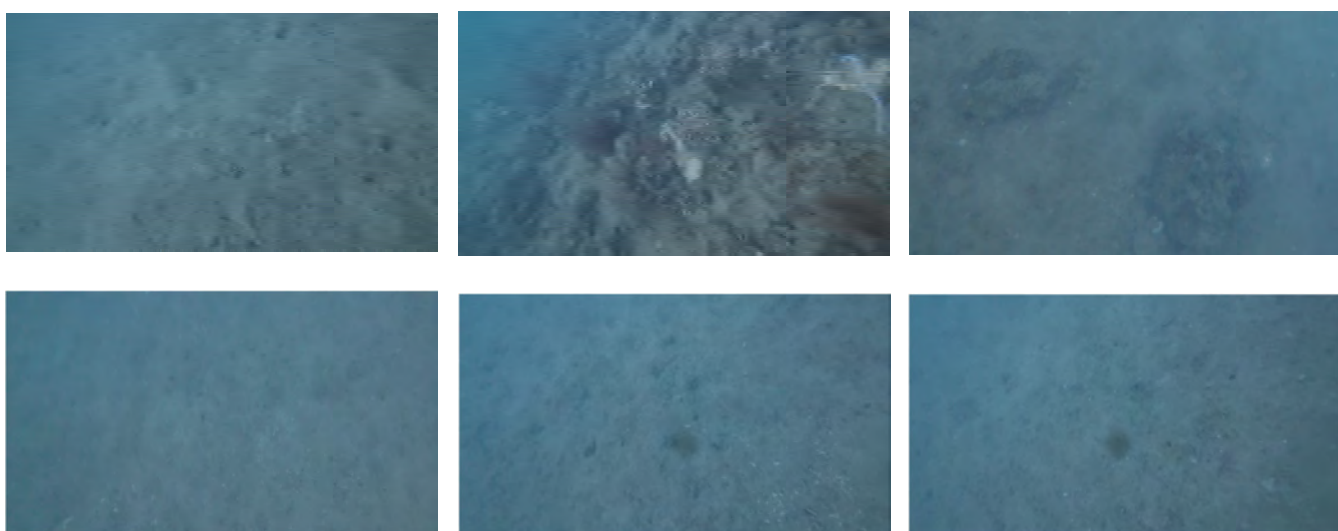


Plate 8 Representative benthic habitat to the far south of the marine footprint recorded during the winter (June 2024) survey. Transect P (Top row), Transect Q (bottom row)



6. Protected Matters Under the EPBC Act

The DCCEE PMST was used in accordance with the Significant Impact Guidelines 1.1 – MNES (DoE 2013), to identify Protected Matters likely to occur within the Study area and relevant to the Project area including:

- Listed threatened marine species and ecological communities
- Listed migratory and/or marine species
- Listed cetacean species
- Ramsar wetlands of international importance
- Listed marine species
- World heritage properties and national heritage places
- Commonwealth marine areas

The PMST report was generated on 25 October 2024 using a 10 km buffer for the search area. Species listed in the PMST were screened by the likelihood of occurrence assessment using the details provided by the PMST and, where available, other sources such as published scientific literature or publicly available datasets. Refer to Appendix B for likelihood of occurrence assessments.

The likelihood of occurrence assessment identified 27 conservation significant species that are confirmed or likely to occur in the Project area. These are broadly described in Sections 6.1 to Section 6.5 below. The full likelihood of occurrence assessment is provided in Appendix B. All records referenced as part of this assessment were obtained through ALA and NR Maps.

It is noted that threatened ecological communities, Ramsar wetlands, world heritage properties and national heritage places were not identified in the PMST and have not been considered further.

Several of these species are only protected in the Commonwealth Marine Area (CMA), which falls outside of the Study area and immediately surrounding waters. However, these species may migrate into NT waters as part of their migratory pathways. While these species are not considered individually as there is no significant impact criteria for listed marine or cetacean species, they do fall under the significant impact assessment for the CMA and are included in that assessment (DoE, 2013). Species listed as conservation dependent under the EPBC Act are not MNES for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals) (DoE, 2013). For detailed information on the Protected Matters identified, refer to the full PMST report in Appendix A.

6.1 Marine reptiles

The PMST and likelihood of occurrence assessment identified seven species of marine reptiles listed as threatened, migratory and/or marine under the EPBC Act that are confirmed to occur or likely to occur in the Study area, including:

- Olive ridley turtle (*Lepidochelys olivacea*) (Endangered)
- Loggerhead turtle (*Caretta caretta*) (Endangered)
- Leatherback turtle (*Dermochelys coriacea*) (Endangered)
- Flatback turtle (*Natator depressus*) (Vulnerable)
- Green turtle (*Chelonia mydas*) (Vulnerable)
- Hawksbill turtle (*Eretmochelys imbricata*) (Vulnerable)
- Estuarine crocodile (*Crocodylus porosus*) (Migratory)

Six species of marine turtle inhabit Australian waters, with all species known to occur in the North Marine Region and listed as threatened species under the EPBC Act. Four of these six marine turtle species are also listed as threatened under the TPWC Act, with the exception of the green turtle (*Chelonia mydas*) and flatback turtle (*Natator depressus*).

The North Marine Region and adjacent regions contain important areas for breeding, nesting, and feeding for multiple turtle species, with globally significant breeding populations of green turtle, hawksbill turtle (*Eretmochelys imbricata*) and flatback turtle found in the area.

The estuarine (or saltwater) crocodile (*Crocodylus porosus*) has a tropical distribution along the northern coastline of Australia and occupies a range of habitats including coastal waters, estuaries, freshwater lakes, inland swamps, marshes, offshore islands and oceanic environments (Webb *et al.* 1987). The saltwater crocodile is listed under the EPBC Act as a protected migratory and marine species and is not listed under the TPWC Act.

6.2 Fish

The PMST and likelihood of occurrence assessment identified 12 species of fish listed as marine under the EPBC Act that are likely to occur in the Study area, including:

- Reticulate pipefish (*Corythoichthys flavofasciatus*)
- Girdled pipefish (*Festucalex cinctus*)
- Mud pipefish (*Halicampus grayi*)
- Spiny-snout pipefish (*Halicampus spinirostris*)
- Ribboned pipehorse (*Haliichthys taeniophorus*)
- Beady pipefish (*Hippichthys penicillus*)
- Spiny seahorse (*Hippocampus histrix*)
- Spotted seahorse (*Hippocampus kuda*)
- Flat-face seahorse (*Hippocampus planifrons*)
- Hedgehog seahorse (*Hippocampus spinosissimus*)
- Bentstick pipefish (*Trachyrhamphus bicoarctatus*)
- Straightstick pipefish (*Trachyrhamphus longirostris*)

Suitable habitat for these species is present within the Study area.

6.3 Sharks and rays

The PMST and likelihood of occurrence assessment identified three species of sharks and rays listed threatened, migratory and/or marine under the EPBC Act and/or the TPWC Act that are confirmed to occur or likely to occur in the Study area, including:

- Green sawfish (*Pristis zijsron*) (Vulnerable)
- Narrow sawfish (*Anoxypristis cuspidata*) (Migratory)
- Scalloped hammerhead (*Sphyrna lewini*) (Conservation Dependent)

Sawfish are modified rays characterised by a shark-like body and a long, flattened snout edged with sharp teeth, resembling a saw. The green sawfish is dually listed under the TPWC Act and the EPBC Act as Vulnerable, whilst the narrow sawfish is listed migratory only under the EPBC Act.

The scalloped hammerhead as a conservation dependent species does not require an assessment under the Significant Impact Guidelines 1.1 – MNES (DoE 2013). It is not listed under the TPWC Act.

6.4 Marine mammals

The PMST and likelihood of occurrence assessment identified five species of marine mammals listed threatened, migratory, marine and/or cetacean under the EPBC Act that are confirmed to occur or likely to occur in the Study area, including:

- Dugong (*Dugong dugon*) (Migratory)
- Indian Ocean bottlenose dolphin (*Tursiops aduncus*) (Marine)
- Australian snubfin dolphin (*Orcaella heinsohni*) (Migratory)
- Australian humpback dolphin (*Sousa sahalensis*) (Migratory)
- False killer whale (*Pseudorca crassidens*) (Cetacean)

The CMA and adjacent NT waters surrounding Groote Eylandt are important for several cetacean species of which nine species are known to occur regularly (six dolphin species, and three whale species) and another 15 cetacean species may infrequently occur (OBIS SeaMap, 2024). There are two EPBC listed migratory dolphin species

(Australian snubfin dolphin, *Orcaella heinsohni*, and the Australian humpback dolphin, *Sousa sahulensis*) which have been recorded in the waters around Groote Eylandt, and in between Groote Eylandt and the mainland. The false killer whale (*Pseudorca crassidens*) and Indian ocean bottlenose dolphin (*Tursiops aduncus*) also were confirmed to occur and are listed as Cetaceans under the EPBC Act. These four species are not listed under the TPWC Act.

The dugong (*Dugong dugon*) is a listed migratory marine species under the EPBC Act and is not listed under the TPWC Act. It is one of only four living species of the order Sirenia. Aerial surveys suggest that a significant proportion of the world's dugong populations occurring in the North Marine Region (Marsh *et al.* 2008). Although more recent aerial surveys have seen fluctuations in observed numbers, they have a continued presence in and around Groote (Northern Territory Government, 2019). Notably, GEMCO stakeholder engagement with TOs in October 2023, identified that the TOs have never seen a dugong in the port area of Milner Bay including areas outside of the Project area.

6.5 Biological Important Areas

Biologically important areas (BIA) are areas that are particularly important for the conservation of protected species and where aggregations of individuals display biologically important behaviour, such as breeding, foraging, resting or migration (DSEWPC, 2012). The presence of the observed behaviour is assumed to indicate that habitat required for the behaviour is also present. BIAs are not formally Protected Matters under the EPBC Act; however, they may be designated within protected areas. The PMST identified three Biologically Important Areas (BIAs) that intersect with the Study area, for the following species:

- Green turtle (*Chelonia mydas*) (Nesting season - August to September)
- Hawksbill turtle (*Eretmochelys imbricata*) (Nesting season - December to January)
- Flatback turtle (*Natator depressus*) (Nesting season - November to May)

These are three mapped internesting BIAs, which denotes the area used by female turtles between laying clutches, where they remain close to nesting beaches or rookeries (DEE, 2017a). Notably, these BIAs cover a very broad area, and include the north and eastern coasts of Groote Eylandt where turtle nesting is more common in the region. These BIAs are considered separate to the Habitat Critical to the Survival of Marine Turtles.

7. Potential impact pathways

The construction and operation of the Project are described in Section 2. Impacts to marine ecosystems arising during these processes can be categorised into three general groups:

1. **Loss of marine habitat** - either via direct removal or significant alteration to marine ecosystems, such that their functionality is lost.
2. **Habitat degradation** - which will alter habitats to varying degrees ranging from minor and recoverable to longer-term and irreversible shifts in community type, structure, or function.
3. **Injury/mortality or disturbance** – either indirectly in response to loss or alteration of habitat, or directly due to activities.

The spatial scale, duration and magnitude of these impacts is influenced by a number of factors relating to the location and design of marine infrastructure, as well as the specific methodologies that may be implemented to undertake the works.

A summary of identified impact sources, impact pathways that could impact marine ecosystems in the Project area have been summarised below in Table 12. Refer to Section 8 for recommended mitigation measures and Section 9 for assessment of residual impacts.

The impact analysis focused on examining the impact pathways individually and then reassessing them in combination to understand their potential to impact on marine ecosystems. The following pathways of impact were reviewed:

- Direct alteration of marine habitat
- Altered water quality
- Underwater noise
- Introduction of marine pests and diseases
- Interaction with vessels
- Other impacts

Table 12 Potential direct and indirect impacts to marine values

Impact source	Impact pathway	Potential impact
Construction of marine infrastructure (Section 7.1)	Removal of benthic habitats	Habitat loss
	Increased suspended sediment concentration and light attenuation	Habitat degradation
	Introduction of marine pests and diseases	
	Altered coastal hydrodynamics, sediment transport and coastal processes	
	Accidental release of hazardous or polluting materials	
	Changes to habitat from the presence of physical structures	
	Vessel strikes or disturbance	Injury/mortality or disturbance
	Underwater noise from sheet piling and excavation of sediment	
	Artificial light	
Operation of pipeline / marine discharge (Section 7.2)	Introduction of marine pests and diseases	Habitat degradation
	Accidental release of hazardous or polluting materials	
	Altered water quality	
	Seabed scouring	

Impact source	Impact pathway	Potential impact
Decommissioning	Introduction of marine pests and diseases	Habitat degradation
	Erosion and increased turbidity and light attenuation	
	Accidental release of hazardous or polluting materials	
	Inadequate decommissioning	

7.1 Construction

GEMCO's provisional construction timeline has work planned to be undertaken between March to December of 2026. The marine construction component is forecast to take 8 months within this period.

7.1.1 Seabed disturbance

During construction, marine habitat will be removed for an open-cut trench for the pipeline's placement. As illustrated in Figure 16, a small patch of macroalgae was observed on the boundary of the construction footprint; this area will be directly impacted by construction works. The remaining habitat that will be directly affected is described as open sandy substrate. Habitat will be altered within the construction footprint with open trenching causing temporary disturbance.

Sediments excavated during trenching are expected to be stored at the Port's existing onshore dredge spoil ponds. The seabed will be reinstated via backfill post-pipeline burial.

A small area³ of primarily open sandy substrate (<6,000 m², assuming 300 m of trenching) will be directly impacted during excavation of the intertidal and surf zone seabed during construction. Of this area, 193 m² comprises the small macroalgae patch observed during field survey activities. An additional <5,500 m² of open sandy substrate (assuming 300 m of trenching) is also expected to be impacted during installation of the on-seabed section of the pipeline and diffuser structure.

The benthic habitat within the construction footprint is well represented at a local level, and in the wider region. There will be direct loss of infauna and sessile organism communities that dwell within the strata of the construction footprint directly by removal (from excavation). The potential for indirect impacts outside of the construction footprint via changes to water quality (suspension / settlement of fine sediments) will be limited via the installation of sheet piles to form a cofferdam within which trenching will occur. Impacts to water quality are therefore expected to be contained to the construction footprint.

Post construction, recovery of the benthic community is expected to occur on a scale of weeks to months. This has been previously observed for dredging seabed disturbances, for example McCauley (1977) identified recovery of infauna to pre-dredging conditions to occur within 28 days of the disturbance ceasing. As such, impacts to communities present on the seabed are expected to be localised and short term, and thus are considered low risk.

It is noted that seabed lay of pipeline will change habitat from soft sediment to hard substrate creating artificial reef opportunity, which is further discussed in Section 7.2.4.

7.1.2 Altered water quality

A change in water quality can result in a range of responses in marine fauna, include avoidance of the area by mobile species and increased susceptibility to predation, disease, and parasites, reduced foraging efficiency and fitness and mortality in other species (Jenkins and McKinnon, 2006; Kjelland et al. 2015; Wenger et al. 2017).

Potential impacts depend on a range of factors including the spatial-temporal scale of the change in water quality, the timing and magnitude of the change, and existing water quality conditions.

³ Area calculated based on marine footprint kmz file provided 9th June 2024 using assumption that trenching pop out point will be approximately halfway along the linear length of the footprint (300 m)

To assess the potential impact of altered water quality on benthic communities, habitat and marine fauna from the Project's construction and operation, a high-level review of potential impact pathways was provided for each stage of the Project (i.e., construction vs. operation).

During the construction phase of the Project, a number of impact pathways with the potential to impact marine water quality have been identified, including:

- Accidental release of hazardous or polluting material direct to marine water from construction vessels, vehicles and mobile plant equipment
Hazardous or polluting materials, such as oil, chemicals, heavy metals, or harmful substances, can interfere with critical physiological processes, leading to acute or chronic health issues, impaired growth, reproductive abnormalities, and increased mortality among marine species. Oil slicks can spread across large areas, coating marine habitats and fauna. Additionally, accidental releases of pollutants can impact microorganisms (plankton) through direct toxicity or indirectly via reduced light availability. Some hazardous and polluting materials may persist in the marine environments for extended periods, resulting in chronic exposure for marine organisms, leading to reduced fitness and resilience.
Most hazardous or polluting materials spills are expected to be minor in nature, with a low potential likelihood of occurrence from the construction vessels (i.e. during on-board maintenance and cleaning) and potentially from land-based works (i.e. fuel spills, oil leaks etc). Hence fuel, oil and chemical spills are considered low risk. Risk of a major oil/fuel spill, associated with breaching of a vessel's hull/fuel tanks is considered to be low.
- Leaching contaminants (polluting materials from accidental releases to soil, PASS)
Accidental releases of pollutants to soil, such as oil spills, chemical leaks, or industrial waste disposal, can result in high concentrations of heavy metals, hydrocarbons, pesticides, and other toxic substances in the soil. When rainfall or irrigation water infiltrates contaminated soil, it can mobilise these pollutants and carry them into adjacent water bodies through leaching processes. Given the mitigation measures proposed (refer Section 8), this impact pathway poses a low risk to the receiving environment.
- The presence of a small amount of PASS was confirmed during sediment sampling and analysis associated with the GEMCO Tug Replacement Project. However, ANC test results also indicated that all sediments possessed a large negative net acidity and therefore a high capacity to self-neutralise if exposed to oxygen (Indo-Pacific, 2022). The report concluded that there was an extremely low risk of contaminant mobilisation due to acidification. Additional PASS analysis of surface sediment samples was undertaken in June 2024 (Section 5.2.3.1); the findings also suggesting that sediments are self-neutralising and low risk.
- Increased erosion and soil loss during land-based construction activities entering the marine environment
Soil erosion in terrestrial areas can lead to increased sedimentation in marine environments, smothering benthic habitats and reducing light penetration into the water column leading to inhibited photosynthesis and reduced primary productivity in marine ecosystems. Furthermore, soils transported to the marine environment can alter the substrate composition and introduce soil-adsorbed pollutants such as heavy metals, nutrients, pesticides, and organic matter. Fine soils can also interfere with the feeding and breathing structures of many marine fauna (fish gills, filter-feeding apparatus of corals, polychaete worms). Given the mitigation measures proposed (refer Section 8), this impact pathway poses a low risk to the receiving environment.
- Increased suspended sediment concentration and potential release of contaminants during construction of marine infrastructure
Increased suspended sediment concentrations in marine environments can have similar impacts to increased soil from terrestrial sources, including, smothering benthic habitats and reducing light penetration. Fine sediments can also interfere with the feeding and breathing structures of many marine fauna (fish gills, filter-feeding apparatus of corals, polychaete worms). As detailed in Section 5.2.2 several total metals (manganese (Mn), zinc (Zn), cobalt (Co), copper (Cu) and lead (Pb)) had elevated concentrations in offshore marine and beach sediment samples near the Port, with concentrations diminishing rapidly with distance away from the Port. This risk for potential release is considered low, primarily due to the limited solubility of these analytes and their ready adsorption to sediment particles. Use of sheet piles during construction will limit the potential for mobilisation of sediments and other contaminants beyond the construction footprint.

7.1.3 Underwater noise and vibration

Numerous marine fauna species are dependent on sound for various biological activities, such as foraging, communication, navigation, and social interaction. Exposure to elevated levels of underwater anthropogenic noise can negatively impact these biological activities, or at the extreme intense noise exposure can lead to injuries or mortalities. The effects of increased anthropogenic noise can be broadly categorised as:

- Behavioural responses, such as displacement, attraction, or avoidance
- Masking or interfering with intraspecific or interspecific biologically significant sounds such as echolocation, signals produced by predators/prey, and vocal communication
- Inducing or exacerbating stress
- Auditory injury and/or impairment
- Direct or indirect mortality

The expected impact and thresholds associated with exposure to underwater noise on marine fauna is highly dependent on the sound source intensity and duration of exposure. Continuous sounds occur without pause and are typically produced by the ambient environment, ships or 'always on' machinery such as pumps. Impulsive sounds are of short duration and occur singly, irregular or as part of a repeat pattern and result from activities such as piling and blasting.

Construction activities including vibratory piling, pipeline placement, vessel movement and excavation, as well as the use of machinery and equipment within and adjacent to the marine environment have the potential to impact noise-sensitive marine fauna.

The main underwater noise sources from the Project will occur during construction and are expected to primarily consist of continuous vibration noise from vibratory piling of the sheet and tubular piles, and excavation of material during trenching.

Impulsive noise sources during construction have been minimised through intentional choice of construction methods (vibratory piling chosen over impact piling) and are therefore not anticipated to occur under the planned construction methodology. Should impact piling become necessary, a detailed underwater noise impact assessment would be undertaken to identify mitigation measures to minimise impacts to marine fauna, including the determination of safety zones and potential effect zones for monitoring of marine fauna presence during works.

This impact assessment describes typical sound scenarios expected to occur during the construction phase and potential impacts to noise-sensitive marine fauna. The assessment is consistent with industry standards and relies on the typical approach to understand noise impacts and thresholds.

Underwater noise criteria typically consider both peak sound pressure level (SPL) and cumulative noise exposure (sound exposure level, SEL). The potential impact area of a noise source and how far away a noise source is, is expected to have an impact on marine mammal species (either behaviourally or physiologically), and this area is defined as the zones of impact.

Three zones of impact are generally described in assessing potential underwater noise impacts (reproduced from Government of SA Underwater Piling Noise Guidelines (Government of SA, 2023)):

- Zone of audibility: Area within which a marine species may hear the source of noise, but not exhibit any significant behavioural response. The size of the zone of audibility is highly dependent on the ambient noise environment.
- Zone of responsiveness: Area within which the considered marine mammal might react behaviourally to the noise source.
- Zone of hearing injury: Area closest to the noise source where the noise levels may be high enough to cause a physiological impact such as temporary threshold shift or permanent threshold shift.

Noise exposure thresholds have been described in published literature for numerous fauna and are summarised below in Table 13 to Table 14 for continuous noise sources.

Table 13 Noise exposure criteria for continuous sounds – dolphins and dugongs

Marine mammal hearing group	PTS* and TTS* threshold levels – continuous noise	
	Injury (PTS) onset	TTS onset
	SEL _{24hr} , dB re 1µPa ² ·S (weighted)	SEL _{24hr} , dB re 1µPa ² ·S (weighted)
Dolphins	198	179
Dugongs	206	186

*PTS = Permanent Threshold Shift; TTS = Temporary Threshold Shift

Table 14 Noise exposure criteria for continuous sounds – fishes and marine turtles

Type of animal	Mortality or lethal injury	Impairment			Behaviour
		Recovery injury	TTS	Masking	
Fish: no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL RMS for 48h	158 dB SPL RMS for 48h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Sea turtles	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) High	(N) Moderate (I) Moderate (F) Low

Notes: root mean square sound pressure levels (SPL RMS) dB re 1 µPa. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

The Noise and Vibration Impact Assessment (GHD 2024c) concluded that construction activities are unlikely exceed the PTS or TTS sound exposure thresholds for dugongs or dolphins at a distance of 10 m or greater from the source, assuming that activities are not undertaken for longer than 12 hours continuously.

Marine fauna closer to the noise sources are assumed to move at least 10 metres from the source to avoid significant SEL. Furthermore, large and highly mobile marine megafauna such as dugongs or dolphins are not expected to remain in the immediate vicinity (i.e. < 10 m) of site machinery for long enough to be exposed to injurious sound levels.

7.1.4 Marine pests and disease

Invasive marine pests (IMPs) are identified as marine plants, animals and algae, which have been introduced into a location that is not within their natural dispersal range, but which provides conditions that support their survivorship (DAFF, 2010). As detailed in Section 5.1.4, three species have previously been identified as potential marine pests for the NT. However, no recognised marine pest species have been recorded around Groote Eylandt (Lason and Skarlatos, 2014) although not all fouling organisms were taxonomically identified.

Vessels carrying IMPs may unintentionally but successfully introduce these species to the region where the activity is occurring. IMPs may be carried within the external biological fouling on the vessel hull, within seawater

pipes (e.g. cooling water) and associated infrastructure or on submersible marine instruments and equipment. Ballast water exchange may also allow for the transportation and proliferation of IMPs within the area of activity.

Before vessels can proceed to the site location, quarantine obligations may have to be fulfilled, particularly for vessels sourced from overseas. Ballast water exchange record requirements will need to be complied with. Internationally sourced vessels will also be required to maintain possession of Australian Quarantine and Inspection Service (AQIS) Clearance documentation in order to verify compliance with Mandatory Ballast Water Requirements or verify biofouling management measures outlined by the AQIS.

IMPs at risk of introduction to the Project area predominantly originate from Southeast Asian countries and from established IMP populations within many Australian ports.

The introduction and proliferation of IMPs typically create irreversible impacts on marine ecosystem and marine function. Ecosystem health, biodiversity, fisheries, aquaculture, human health and waterway industries including tourism are at potential risk from the impacts of IMPs (DAFF, 2010). The extent of the detrimental effects introduced marine pests may have includes depletion of viable fishing areas and aquaculture stock, out-competing native flora and fauna, over-predation of native flora and fauna, reduction of coastal aesthetics and increased maintenance costs, human illness through released toxins, reduction in vessel performance, damage to vessel engines and propellers and damage to industrial infrastructure.

The colonisation of new hard substrate by biofouling species is not a rare occurrence. However, the physical, chemical and biological circumstances of the environment into which the species has been introduced are important determining factors as to whether the species will successfully establish and become an invasive pest. Flora and fauna species atypical to the region can be attracted to newly created hard substrate habitats, such as those that would be provided by the presence of the submerged pipeline and diffuser structure. The new habitat is however, expected to accommodate native species from surrounding habitats which had previously limited access to available hard substrate habitats within the Project area.

The following controls and processes may be employed in order to mitigate or eliminate the risk of introducing pests:

- Vessels should be sourced locally (within the NT) wherever possible.
- All vessels working on the Project, whether internationally or locally sources, will adhere to Australian quarantine requirements.
- The management of ballast water prior to entry to Australian waters must follow AQIS guidelines and compliance requirements in relation to marine pest introduction risk management for any internationally sourced vessel.
- Vessels landing at the port should adhere to GEMCO's Biosecurity Inspection procedure including visual inspection for pest animals or plant material, complete FRM-30601 Barge Biosecurity Inspection Record.
- Any additional vehicle, equipment or containers being brought to Groote Eylandt should adhere to the Biosecurity Inspection procedure requiring a visual inspection and completion of FRM-30605 RORO Biosecurity Inspection Record.
- GEMCO's Port Regulations and Guidelines for Arriving Masters provides for environmental protection from marine pests by stipulating that vessels shall not pump out bilges within Milner Bay Port limits, ballast water is not to be discharged onto the wharf and vessels with common ballast and bilge stripping educators must ensure that valves to the bilge system are closed.

It is important to note that the Project area lies within the existing Port limits, where cargo ships routinely dock to receive ore from the GEMCO mining operations and that Port operations present a risk of IMP introduction that is managed under Australian and International biosecurity and ballast water requirements.

7.1.5 Fauna interaction

There is potential for collision to occur between marine fauna and vessels associated with the proposed works. This risk is particularly pronounced concerning possible collision between large slowly moving marine fauna and a vessel or deployed equipment.

The impacts of vessel operations on marine fauna ranges from minimal and temporary (i.e., short-term behavioural change/avoidance) to severe and permanent (i.e., injury or death as a result of a direct collision with

construction vessels). Recovery plans and conservation advice for many marine species (whales, cetaceans, sirenians and turtles) recognise vessel strikes as an identified threat.

During construction and installation of the pipeline and diffuser infrastructure, vessels will be used to lay marine components of the pipeline (refer to Section 2 for details) and will be operating in areas with known marine megafauna occurrences.

The likelihood of an interaction of vessel/vehicles with marine fauna is determined by the overlap of vessel traffic and marine fauna. The outcome of such an interaction is strongly dependent on vessel speed. Faster moving vessels pose a greater risk of collision compared to slower vessels (DoEE 2017) with the most severe and lethal injuries to marine fauna attributed to vessels moving at greater than 14 knots (Laist *et al.* 2001). Additionally, fauna behaviour can also influence the potential for a vessel collision, particularly when an individual is feeding, mating, or nursing (Laist *et al.* 2001).

Specific details on the vessels used for the construction phase are not determined at the time of this report, and as such, information on vessel movements is sourced from similar Projects. During construction, pipelay vessels are slow moving (<1 knot) and subsequently are not expected to present a likely risk of vessel collision with marine fauna.

The timing of construction activities is currently unknown, therefore there is potential that construction may overlap with the migratory windows of conservation-significant marine species (Section 5.1.3). Even if whales are present, movement of construction vessels and the construction activity is not considered a direct threat as the Project area is already heavily utilised by vessel movements from day-to-day Port operations. Furthermore, the average service speed of construction vessels is expected to range between 5-10 knots during transit to the Project area and will be largely stationary or very slow-moving during construction.

As detailed in Section 6 conservation-significant species are likely to transit the Project area; however, are considered relatively able to navigate away from vessels undertaking these construction activities. The risk of potential vessel strike is therefore considered low for all marine species, including cetaceans, marine turtles, sirenians, pinnipeds and fish. This risk accounts for the avoidance behaviour marine fauna species adopt to evade vessels until the vessel disruption has elapsed.

7.1.6 Changes to coastal processes

Potential impacts to coastal processes are expected to be temporary in nature and localised to the construction footprint. Potential impacts during construction are to changes to accretion as a result of temporary sheet piling. Intertidal/surf zone works are anticipated to run for approximately 8 months through which time sheet piling will be used to reduce impacts to the seabed and limit excavation footprint from trenching through the surf zone (i.e. sheet piling to limit the excavation footprint, as opposed to open excavation which requires a stable batter slope that increases footprint).

Sheet piling will be installed and removed within this 8-month window. Removal will occur once trenching has been backfilled following pipeline installation. The sheet piling is expected to be 200-300 m in length along the alignment from the sump to the end of the surf zone (~5 m water depth); and stand above the water surface. The sheet piles will create a cofferdam, to allow extraction of water within the structure and limit plume dispersion footprint during excavations. As the result of the cofferdam intercepting the longshore current, a small amount sediment accretion may take place on the up current sides of the structure. This accumulation on the up current sides is anticipated to be resolved with the subsequent removal of the cofferdam. Resulting beach erosion risk would be monitored following storm events visually throughout construction. No areas of coral or bouldering were identified immediately adjacent the construction footprint that would be impacted by this accretion.

The pipeline will be buried under the beach and through the surf zone, resurfacing at approximately 5 m of water depth, following the completion of construction it is anticipated that the natural sediment transport processes through this surf zone will resume and continue. The pipeline, from 5 m of water depth onwards, is likely to be exposed to ongoing underwater sediment accretion mechanics throughout its life with sediment accretion on the up currents side of the pipeline. With water exchange occurring over the pipeline and water depths of approximately 5 - 10 m, a lower accretion impact is expected to occur compared to the shallower surf zone construction works.

With effective design measures for storm surge (including consideration of pipeline burial depths) and implementation of mitigation measures, including the development and implementation of a Construction Environmental Management Plan (CEMP), the application of GEMCO standard operating procedures and emergency response plans, the risk and impact to coastal processes as a result of the project construction is considered low.

7.2 Operation

7.2.1 Marine discharge

7.2.1.1 Historical discharge water quality

During the operation phase of the Project, the marine discharge has potential to impact marine water quality, including via changes to physiochemical parameters, and concentrations of metals and metalloids, and nutrients. Further information is provided following, with results of the marine discharge modelling presented in 7.2.1.2.

Physiochemical parameters

- **Salinity:** changes in salinity changes can disrupt osmoregulation in marine organisms, leading to physiological stress, impaired growth, reduced reproductive success and species distribution of benthic communities and marine fauna. Additionally, salinity fluctuations can alter water density and stratification patterns, affecting nutrient cycling and habitat availability for marine species. The water to be discharged is relatively fresh, as such a buoyant plume is predicted (refer to 7.2.1.2 for modelling results). Impacts to sensitive receptors on the seabed (such as corals or seagrasses beyond the construction footprint) are therefore not predicted.
- **pH:** decreasing seawater pH is particularly impactful on calcium carbonate marine organisms (corals, molluscs, and echinoderms), affecting calcification rates, shell formation, reproductive success, reduced growth, altered energy efforts, and impaired survival rates. Changes in pH can impact the physiology and behaviour of marine species and benthic species community composition and abundance. The water to be discharged has historically been recorded as mildly to moderately acidic.
- **Turbidity:** elevated turbidity levels reduce light penetration into the water column, affecting photosynthesis and primary productivity in marine ecosystems. Reduced light availability can also smother benthic habitats such as coral reefs, seagrass beds, and rocky substrates, leading to decreased growth rates, altered community composition, and impaired reproductive success in marine organisms. Turbidity impacts as a result of marine discharge are expected to be minimal.

Altered metals/metalloids concentrations

Increased metal and metalloid concentrations can have several lethal and sub-lethal effects on benthic organisms, habitats, and marine fauna. Where the environment is notably contaminated, communities become simplified, dominated by a few tolerant species able to survive and reproduce. Alternatively physical abnormalities may also occur, or areas can become inhospitable and devoid of fauna and flora.

A review of historical discharge water quality was completed by IndoPacific Environmental (IPE); this is detailed in Section 5.2.2. Most metals and metalloids had low median values (measured in µg/L) with low detection rates ranging from 1% to 31%, with the exceptions of manganese (100%), strontium (98%) and barium (76%). It should be noted that the most recent water quality sampling event in June 2024 indicated that metal concentrations are not present in elevated concentrations above the adjusted LORs.

The ANZECC guidelines provide a low reliability trigger value of 80 µg/L for manganese in marine waters (ANZECC and ARMCANZ, 2000), which is higher than the recorded historical median of 51 µg/L.

Neither strontium nor barium currently have ANZECC trigger values, with historical median values in discharge water of 10 µg/L and 2 µg/L, respectively. Ambient levels of strontium and barium have been determined in sea water by Bowen (1956), as 8.5 mg/L (or 8,500 µg/L) and 6.2 µg/L, respectively. This suggests that the historical discharge water quality values are within the expected ranges of ambient sea water conditions.

These results indicate that metals and metalloids in discharge water present negligible risk to the receiving marine environment.

Increased nutrients

- Increasing algal biomass provides a continuous source of organic matter, forming organic detritus through the decomposition processes. As decomposition requires the breakdown of oxygen, oxygen can become limited on the sediment surface (hypoxic) and eliminated altogether (anoxic) (Nielson and Jernakoff 1996). These conditions become lethal for a range of fauna at different levels; although mobile animals will leave the area and sessile species suffer mortality.
- Algal blooms can produce toxins that will bioaccumulate to lethal levels in a range of species, including those of socio-economic importance (molluscs, crustaceans, echinoderms) and cause the loss of herbivorous and predatory species (Williamson *et al.* 2002). However, any elevated nutrients are expected to be rapidly dispersed and diluted by currents in the region (refer Section 7.2.1.2).

7.2.1.2 Marine discharge modelling

To understand the potential impacts associated with marine discharge to the marine environment, hydrodynamic modelling of a marine discharge scenario was undertaken by GHD in August 2024 (GHD, 2024b). This included the following scope:

- Near-field modelling of a range of outfall configurations was undertaken to recommend an appropriate diffuser concept design for the marine discharge. The concept design selected is a ~150 m long diffuser of 30 alternating 150 mm ports discharging north-westward and south-eastward at the seabed with an average depth of ~8.5 m.
- Marine preliminary benchmark values were adopted that were derived from available site-specific water quality data and proposed trigger values developed by IPE (2023). Dilution targets were defined for a range of parameters within the discharge.
- A three-dimensional (3D) far-field hydrodynamic model was developed, calibrated and validated for the south-western region of the Gulf of Carpentaria with refined resolution in the vicinity of Groote Eylandt and the proposed marine outfall site.
- The diffuser concept design was incorporated into the 3D far-field model and a range of discharge flowrates were simulated over a one-year simulation to account for seasonally varying met-ocean conditions at the site. The discharge scenario was simulated as 80 GL/year, which was considered a conservative approach for the assessment.

Previous reports (IndoPacific Environmental 2023, WSP 2023) have reviewed scientific literature and previous monitoring results for the marine water⁴, marine sediment and discharge quality and determined appropriate preliminary benchmark values to maintain marine ecosystem function and minimise potential impacts to the marine environment. The outer extent of the area in which all preliminary benchmark values are achieved for 99% of the time has been used to define the edge of the predicted mixing zone.

The scenario modelled is 'worst case' and the outcomes are therefore considered environmentally conservative, for the following reasons:

- The discharge of 80 GL/a defined by GEMCO represents the assumed peak flow. The discharge rate in the model was held constant over a one-year duration simulation and therefore overestimates the likely discharge volumes on an annual timescale, which during operations are expected to average 60 GL/a.
- Concentrations of analytes within the discharge were generally defined as the 95th percentile of historical measurements from the site and therefore are over-estimates of loads for the majority of the time.
- Though the hydrodynamic model was verified with measured currents that were well reproduced, current speeds are marginally under-estimated. The resultant reduction in simulated flushing of the nearshore environment relative to actual conditions therefore likely represents an over-prediction of the mixing zone spatial extent in general due to less volumetric dilution.
- All water quality analytes (with the exception of pH, which was evaluated with a separate model that accounts for pH buffering processes) were treated as numerically conservative tracers, neglecting transformative processes (degradation, decay, biological uptake) that may otherwise occur for some analytes

⁴ Marine water monitoring accounts for current anthropogenic influences on water quality, such as potential changes to water quality associated with the sewage outfall.

and will lead to lower concentrations during operations than those simulated here. In general, this assumption will over-estimate the spatial extent of the mixing zone.

Based on conservative assumptions of discharge quality and a quantity of 80 GL/year, dilution targets of 42-fold for the mixing zone of **potential indirect effects** related to nitrate enrichment, and 35-fold for the mixing zone for **potential direct effects** related to salinity reduction have been defined for this study. The indirect effects are only likely to represent a risk if the receiving marine environment is not flushed rapidly enough, with algal blooms potentially arising in stagnant zones. Further, potential direct effects related to salinity reduction are only expected to yield ecological impacts when occurring at the seabed in the presence of benthic primary producers (seagrass or corals) that are unable to escape the plume; as the modelling predicts there will be no plume-seabed interaction, this is unlikely to occur.

The predicted mixing zone is presented in Figure 17 where the zone of potential indirect effects are represented by the 42-fold dilution contour (light grey) and the zone of potential direct effects are represented by the 35-fold dilution contour (light blue).

The far-field simulations yielded the following predictions:

- The outer extent of the surface mixing zone for **potential indirect effects** (42-fold dilution target related to nitrate enrichment) is predicted to extend ~650 m north and ~550 m southeast from the diffuser.
- The outer extent of the surface mixing zone for **potential direct effects** (35-fold dilution target related to salinity reduction) is predicted to extend ~400 m north-northwest and ~350 m southeast from the diffuser.
- There was no predicted mixing zone at the seabed due to the buoyant nature of the plume (Figure 17).
- Potential ecological impacts from elevated turbidity are predicted to be constrained to the immediate vicinity of the diffuser (i.e. within 30 m). It is noted that this area does not contain sensitive photosynthesisers such as corals and seagrasses.
- Predicted flushing rates of the near-shore receiving waters encompassing the mixing zone are rapid, with e-folding timescales (the time to exchange ~67% of the volume with surrounding ambient waters) averaging 16 hours and ranging from 6 hours at a minimum to 35 hours maximum. The PIANC (2008) standard for marinas states e-folding times of less than four days represent good flushing.

It is noted that the plume is predicted to be buoyant, with no predicted impact to the seabed and associated benthic assemblages resulting against the benchmark value for salinity (Figure 17– light blue 35-fold dilution factor for salinity dilution; see Section 7.2.1.2 for further details). Increased vertical mixing of the plume may occur under certain high wave conditions, which may result in short-term exposure of benthic habitats at the seabed to the plume beyond what is predicted in the modelling (which neglects waves). However, Groote Eylandt itself causes a high degree of sheltering from Gulf of Carpentaria swells, with wave heights of less than 0.5 m being typical of the site for most of the year. Large wave events that may cause the plume to mix to the seabed will primarily occur during storm conditions in which the level of energetic mixing (and plume dilution) will be high. Under such circumstances, it is unlikely that the salinity benchmark value will be exceeded at benthic habitat sites for any duration long enough to generate ecological impacts.

Indirect impacts to surface water quality including potential algal blooms or eutrophic events may arise as a result of nitrate enrichment (Figure 17– light grey 42-fold dilution factor for nitrate dilution), though this is only likely to occur in poorly flushed systems, whereas the modelling predicts excellent flushing rates of the receiving waters (16 hours average, 35 hours maximum readily meets the PIANC (2008) standard for ‘good’ flushing of less than four days).

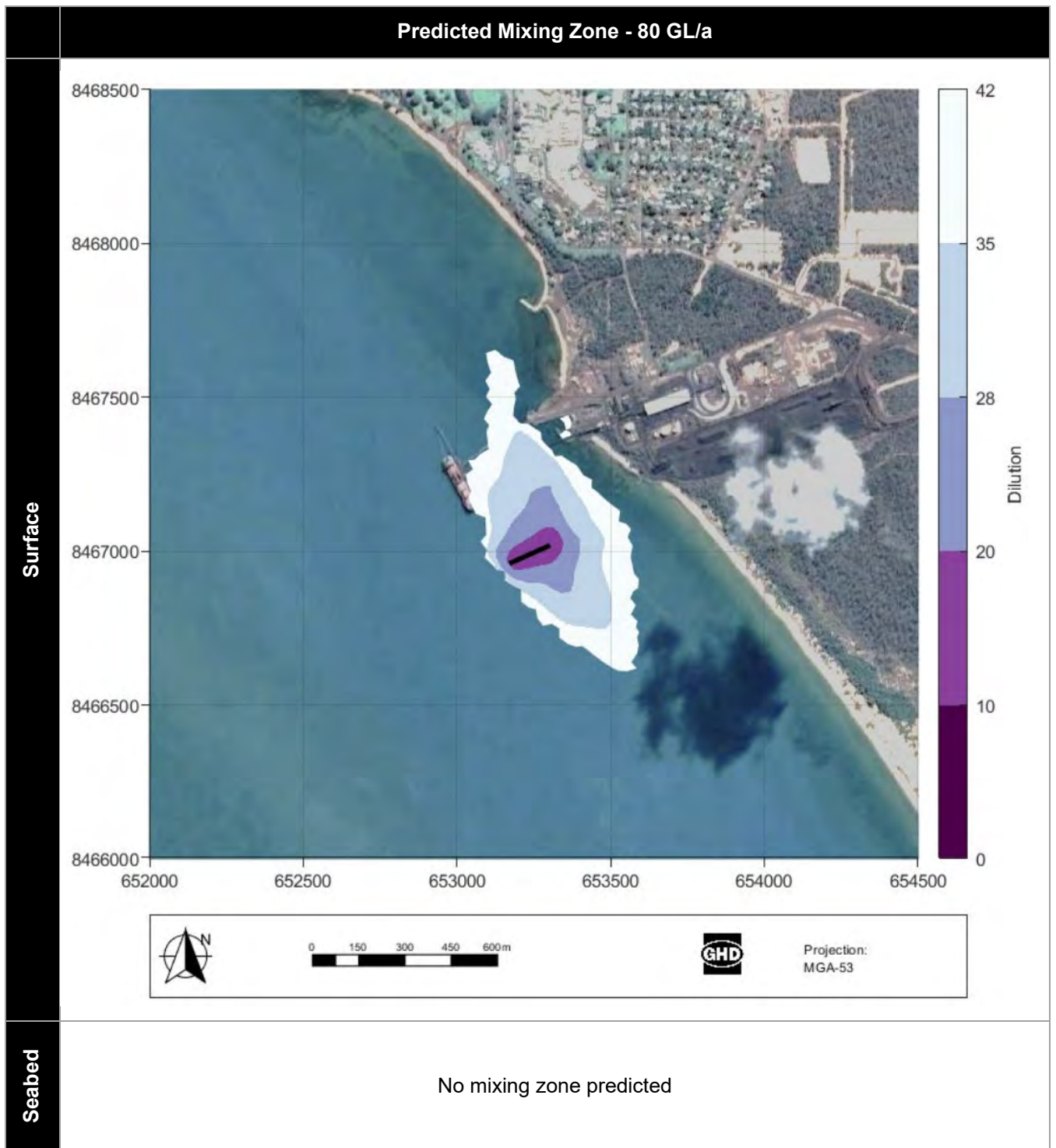


Figure 17 Predicted mixing zone

7.2.2 Seabed scouring

Seabed scouring can occur within the mixing zone as the discharge plume interacts with the seabed. The diffuser infrastructure has been designed such that interaction with the seabed is minimised, with the mixing zone predicted to be vertically constrained to surface waters (i.e. plume is less dense than ambient ocean waters and will therefore 'float') and not anticipated to interact with the benthos. As such, seabed scouring is not anticipated to occur.

7.2.3 Accidental releases

This impacts of hazardous or polluting materials, such as oil, chemicals, heavy metals, or harmful substances, are similar to those outlined in the earlier section (7.1.2). Hence fuel, oil and chemical spills are considered low risk.

7.2.4 Habitat creation

The installed marine infrastructure will provide a substrata for biofouling communities (e.g. molluscs, sponges, bryozoans, crustaceans and ascidians) similar to those observed on natural hard substrata in the region (Section 5.3.2). This is expected to have an overall positive impact, however, habitat creation may also lead to the establishment of marine pest species if introduction vectors are present, via the creation of new habitat (see Section 7.2.6).

Settlement of, and colonisation by, sessile, encrusting and biofouling organisms on the hard substrata of the submerged marine structure is expected to commence immediately following installation, after which, the biofouling community will undergo a long-term natural recruitment succession process (Hamer and Mills, 2015). It is expected that a mature community, comparable to that currently present on natural hard substrate in the region may be achieved within a few years.

A large body of scientific evidence shows that pipelines and associated infrastructure support diverse and abundant fish assemblages by acting as artificial reefs (e.g. Bond *et al.* 2022; Birt *et al.*, 2023).

Communities are expected to be dominated by a variety of sponges, ascidians, cnidarians, and algae, supporting an array of invertebrate and fish species, similar to the ecology on and around the Project area (Section 5.3.2).

Whilst habitat creation may be perceived as a positive impact, the colonisation of the submerged marine infrastructure will require regular maintenance activities to maintain adequate flow velocities at the outlets. Such activities come with risks associated with vessel movement (refer to Sections 7.1.4 and 7.1.5) and maintenance activities on slow-moving and sessile marine species (Section 5.3.2).

Artificial structures may also facilitate IMP proliferation through provision of habitat for establishment of non-indigenous species (Glasby *et al.*, 2007), particularly in the Project area which is characterised by stretches of open substrate absent of extensive hard substrata habitat (refer to Section 5.3.2).

7.2.5 Species abundance and diversity

As noted by the marine discharge modelling (refer Section 7.2.1), the generated plume is predicted to remain buoyant, and therefore is not anticipated to interact with sensitive benthic receptors such as the corals that are located to the north of the construction footprint. Hence risk and impact to benthic fauna species abundance and diversity as a result of marine discharge is considered low.

It is anticipated that there will be periods when marine discharge will not occur, associated with site water use requirements, or during pipeline maintenance activities. As noted in Section 7.2.4, installation of the pipeline will act as an artificial reef creating habitat for biofouling communities and attracting fish assemblages. Consideration has been given to the potential for fish or other small mobile species to become entrained or entrapped during periods when discharge is not occurring. Design of the pipeline has included the incorporation of duckbill check valves (or similar) to stop reverse flow of water from the receiving environment and prevent fauna from entering the pipeline during no flow conditions. With the inclusion of this design feature, the risk and impact to mobile fauna species abundance and diversity as a result of entrapment or entrainment is considered low.

7.2.6 Marine pests and disease

Operation of the Project may require the use of vessels for maintenance works such as repairs or cleaning of the diffuser. As such there is potential for marine pest and pathogen introduction (refer to Section 7.1.4), however these activities are expected to fall within existing routine maintenance operations routinely undertaken by the Port. As the Project lies within Port limits, these activities are not expected to result in a significant increase in the risk of IMP or pathogen introduction.

7.2.7 Fauna interaction

As mentioned above, operation of the Project may require the use of vessels for maintenance works such as repairs or cleaning of the diffuser. As such there is potential for marine fauna interaction during these works (refer to Section 7.1.5), however these activities are expected to fall within existing routine maintenance operations routinely undertaken by the Port. As the Project lies within Port limits, these activities are not expected to result in a significant increase in the risk of fauna interaction.

7.3 Decommissioning

When mine operations cease, there are two options for decommissioning: retaining marine infrastructure in place or partially removing the outfall pipe and/or diffuser structure from the seabed.

If the outfall pipe and diffuser structure is kept in place, there is no further disturbance impact predicted on the environment as it would already have been present in the environment for a nominated period of time.

Rather, the infrastructure will continue to provide hard substrate for recruitment of sessile organisms, forming biogenic habitat likely to support an array of invertebrate and fish species, similar to the ecology on existing hard substrate in the region.

If the marine infrastructure is to be removed, the impacts to the environment would be considered similar to the impacts of installation. This would include resuspension of sediments, disturbance of established benthic habitats and organisms, interference with marine fauna and other potential risks associated with vessel operations previously discussed in this report may be realised.

Operation of vessels and barges to remove the marine infrastructure would also result in additional impacts from generation of shipping related artificial light, artificial noise, planned discharges and atmospheric emissions. It would also carry risk of unplanned impacts discussed earlier in this report occurring as a result of liquid and solid waste spills and marine fauna collisions/entanglements.

If the pipe and marine infrastructure is to remain, the environment will be maintained in the same condition as it was for the lifespan of its operation without any discharge.

The activities associated with removal of the pipe and marine infrastructure would be expected to disturb the seabed and benthic habitats. The area of disturbance would be dependent on methods to be applied for retrieval of the infrastructure at the time of decommissioning. The marine infrastructure removal activities would occur in/over benthic habitats that are currently widely represented at a regional scale. Localised, short-term disturbances to sediments would therefore be expected to occur. More permanent impacts would be expected to the established sessile organisms living on the marine infrastructure as a result of habitat removal.

GEMCO has elected for a decommissioning approach consisting of removal of the marine infrastructure. Any future decommissioning review will take into account potential risks at the time of the proposed action adopting leading industry practices and identify measures/strategies for any proposed action that have the lowest practical environmental impact risk.

8. Recommended impact management and mitigation measures

During the proposed works, GEMCO and the respective construction contractors will implement suitable and relevant mitigation hierarchy measures to protect marine ecosystems as far as is reasonably practicable. These measures include management frameworks, strategies and plans in conjunction with mandates under NT and Commonwealth legislation.

Numerous general management measures not specific to protecting the marine ecology will be implemented to manage potential impacts associated with the Project's construction and operation. At a minimum these will include:

- Mandatory requirements for handling hazardous and/or polluting materials, including storage and transfers in accordance with industry standards, appropriate code of practice and manufacturing directions,
- Development and implementation of environmental management plans for the construction and operational phase of the Project, and
- Emergency response plans.

Furthermore, inclement weather conditions including strong winds, heavy rainfall and storm surges can frequently occur during the wet season resulting from tropical lows and cyclones. The Project design and construction will consider storm surge and rising sea levels and the construction methodology and timeframes will have in place appropriate measures for the climatic conditions that may occur with relevant emergency plans in the event of inclement weather events.

Management and mitigation measures specific to protecting the marine ecosystem and marine environmental values from potential impact pathways described in Section 8 are provided in Table 15 to Table 17 below. These will be embedded in the environmental management plans to be developed for the Project.

Table 15 *Impact management and mitigation measures for potential impacts during construction*

Potential Impact	Management and mitigation measure
Seabed disturbance	To reduce or eliminate the impact of seabed disturbance, a number of design and management controls can be implemented when possible: – Development and implementation of a Construction Environmental Management Plan (CEMP) to support management of excavation activities. – Construction method would consider option with least disturbance to seabed area. – Excavation/trenching/piling should be optimised such that turbidity / plume generation is minimised. – Excavation is expected to occur in a corridor between parallel sheet piles (to maintain trench integrity during pipeline installation); sheet piles will act as a boundary structure preventing unconfined plume expansion. Should trenching occur beyond the boundary of the coffer dam/sheet piles, silt curtains will be used to minimise plume expansion. – Where applicable, an Erosion and Sediment Control Plan should be developed and implemented for land-based activities relevant to the marine footprint (such as excavation through the beach zone). – Development of a monitoring program as part of the CEMP that will include monitoring of turbidity and other relevant water quality parameters (i.e. pH and dissolved oxygen) during seabed disturbance works. – Sediment removed via trenching will be reinstated. Where reinstatement is not possible sediment will be placed within Port's existing onshore dredge spoil ponds. Dredge spoil management plan will be included in the CEMP to manage the release of sediment/pollutants to surrounding sensitive receptors during transport and storage.

Potential Impact	Management and mitigation measure
Altered water quality	The following controls will be adopted in order to mitigate or eliminate the potential for the spillage of hydrocarbons, environmentally hazardous chemicals and liquid-waste to the marine environment for all construction methods: – Monitoring of relevant water quality parameters during works as required by the CEMP. – Chemicals and hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL Annex I, II and III regulations. These include provisions for all chemicals (environmentally hazardous) and hydrocarbons will be stored in closed, secure and appropriately bunded areas. – A Safety Data Sheet (SDS) will be available for all chemicals and hydrocarbons in locations nearby to where the chemicals/wastes are stored. – GEMCO's existing spill procedures should be reviewed and where necessary updated with regard to the proposed construction works and the CEMP. These procedures will be adhered to throughout the construction activities. – Vessel operators will have an up-to-date Shipboard Oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan (SMPEP). All shipboard chemical and hydrocarbon spills will be managed in accordance with these plans by trained and competent crew. GEMCO's existing spill management procedures will be adhered to. – Spill exercises will be conducted at minimum of every three months and recorded in the vessel log. – Spill kit will be located near high-risk spill areas. – Spills will be cleaned up immediately, spill kits re-stocked and clean up material contained, and not washed overboard. – Any contaminated material collected will be contained on board for appropriate onshore disposal. – Spill clean-up equipment will be located where chemicals and hydrocarbons are stored and frequently handled (i.e. 'high risk' areas). The quantity of spill recovery materials will be appropriate to the quantity of stored chemicals. – Any equipment or machinery with the potential to leak oil will be enclosed in continuous bunding or will have drip trays in place where appropriate. – All hoses for pumping and transfers will be maintained and checked as per the pump management system (PMS). – On board oily water disposal will be managed in accordance with the <i>Marine Pollution Regulation 2003</i>. The vessel operator will record the quantity, time and onshore location of the oily water disposal in the vessel Oil Record Book. The following controls will be implemented for the purposes of mitigating or eliminating the risk of the spillage of hydrocarbon from refuelling of vessels or machinery onboard: – Refuelling operations will be a manned operation. In the event the refuelling pipe is ruptured, fuel bunkering will cease. – Spill clean-up equipment will be located where hydrocarbons are stored and frequently handled (i.e. 'high risk' areas). – Refuelling of a vessel will only occur in port and in suitable weather conditions. – Dry-break refuelling hose couplings and hose floats can be installed on the refuelling hose assembly.
Underwater noise and vibrations	The following controls will be implemented for the purposes of decreasing or mitigating the impact of underwater noise on marine fauna: – Vessel, trenching and piling machinery will be maintained in accordance with the manufacturer specifications to reduce noise emissions. – Pre-start checks of the piling area (including a radius of 15 m around the machinery) for marine mammals or marine turtles. – Soft starts to be incorporated into all piling activities. Should impact piling be required at any time during construction, a detailed underwater noise impact assessment will be undertaken to determine safety zones and potential effect zones and identify specific mitigation measures to minimise impacts to marine fauna.

Potential Impact	Management and mitigation measure
Marine pests and pathogens	The following controls and processes will be employed wherever practicable in order to mitigate or eliminate the risk of introducing pests: – Vessels should be sourced locally wherever possible. – All vessels working on the Project, whether internationally or locally sources, will adhere to Australian quarantine requirements. • The management of ballast water prior to entry to Australian waters must follow AQIS guidelines and compliance requirements in relation to marine pest introduction risk management for any internationally sourced vessel. • Vessels landing at the port should adhere to GEMCO's biosecurity inspection procedures including visual inspection for pest animals or plant material.. • Any additional vehicle, equipment or containers being brought to Groote Eylandt should adhere to the biosecurity inspection procedure requiring a visual inspection.. • GEMCO's Port Regulations and Guidelines for Arriving Masters provides for environmental protection from marine pests by stipulating that vessels shall not pump out bilges within Milner Bay Port limits, ballast water is not to be discharged onto the wharf and vessels with common ballast and bilge stripping educators must ensure that valves to the bilge system are closed.
Fauna interaction	The following controls will be adopted and executed for all construction methods to mitigate or eliminate the risk of collision between vessels and marine fauna: – Operations of vessels will follow the vessel disturbance and vessel strike mitigations outlined by the <i>Australian Guidelines for Whale and Dolphin Watching</i> (Commonwealth of Australia, 2017) and the <i>National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna</i> (Commonwealth of Australia, 2017). This includes the implementation of the following guidelines: • Reducing vessel speed to as low as is reasonably practical within the Port Limits and adhere to standard speed limits within and around the construction footprint. • Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone. • Caution zone must not be entered when calf (whale or dolphin) is present. • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod or follow directly behind. • If there is a need to stop, reduce speed gradually. • Do not encourage bow riding. • If animals are bow riding, do not change course or speed suddenly.

Table 16 *Impact management and mitigation measures for potential impacts during operation*

Potential Impact	Management and mitigation measure
Altered water quality due to maintenance activities	As per Table 15.
Altered water quality from marine discharge	– Validation monitoring to be undertaken to validate the outcomes of the marine discharge modelling. Results of the validation monitoring program are to be used to inform the existing GEMCO MEMP and any possible amendments. – A review of the GEMCO MEMP to be undertaken based on the outcomes of the validation monitoring. Additional monitoring locations to be added to the MEMP, if required. Consideration will also be given to frequency of monitoring, based on the outcomes of the validation monitoring. – Monitoring of the receiving environment to be undertaken under the revised GEMCO MEMP. – Monitoring of discharge water quality to be undertaken during discharge activities; data will be used to support interpretation of the receiving environment monitoring results.
Habitat creation	To manage the impacts to created habitat, the following controls will be implemented: – Maintenance of the outfall structure shall seek to avoid slow-moving or cryptic protected species such as syngnathids.
Species abundance and diversity	– As stated in Section 7.2.5, the discharge plume is predicted to be buoyant with no influence on benthic habitats. Validation monitoring of the plume should be undertaken to confirm the Marine Discharge Model predictions associated with plume buoyancy (and therefore no impact to benthic habitats).
Marine pests and pathogens	As per Table 15.
Fauna interaction	As per Table 15.

Table 17 *Impact management and mitigation measures for potential impacts during decommissioning*

Potential Impact	Management and mitigation measure
Decommissioning	– The decommissioning of pipeline infrastructure will be included in the GEMCO Closure Plan. – If the infrastructure is to be removed, management and mitigation measures proposed for impacts associated with pipeline construction/laying activities shall be considered.

9. Residual Impacts

Following the implementation of the avoidance and mitigation measures described in Section 7.2, the potential for residual impacts from the Project's construction and operation to MNES must be assessed.

The residual impacts are summarised below with the significant impact assessment to MNES provided in Appendix C.

9.1 Residual impact assessment methodology

In assessing the significance of residual impacts for each marine environmental value, the approach was dependent on the value and its listing under the EPBC Act.

Residual impacts to benthic communities and habitat were assessed in respect to the amalgamated effect of the Project's direct and indirect impact, and the effectiveness of the measures proposed in Section 8 to avoid and mitigate those impacts. The residual impact assessment considered the severity (scale, duration and magnitude) of the predicted impact, and the importance and sensitivity of the valued component.

Residual impact assessments for marine conservation species were completed in accordance with the 'EPBC Significant Impact Guidelines 1.1' (DCCEEW 2013).

9.2 Significance of residual impacts

During the Project's construction and operation, there is a potential for impacts to EPBC-listed marine species. A significant impact assessment was undertaken in accordance with criteria defined in 'Matters of National Environmental Significance: Significant impact guidelines 1.1' (DoE, 2013) for species considered "confirmed to occur" and "likely to occur" (refer to Appendix C). This assessment has incorporated the application of the avoidance and mitigation measures identified in Section 8. The results summarised in Table 18 show that no significant residual impacts to MNES and/or TPWC Act listed threatened species are anticipated.

Table 18 Summary of Significant Impact Assessment

MNES Group	Species	Result
Critically endangered and endangered species		
Marine reptiles	Olive ridley turtle	No significant residual impact
	Loggerhead turtle	No significant residual impact
	Leatherback turtle	No significant residual impact
Vulnerable species		
Marine reptiles	Flatback turtle	No significant residual impact
	Green turtle	No significant residual impact
	Hawksbill turtle	No significant residual impact
Elasmobranchs	Green sawfish	No significant residual impact
	Narrow sawfish	No significant residual impact
Migratory species (not otherwise listed as threatened)		
Marine mammals	Dugong	No significant residual impact
	Australian snubfin dolphin	No significant residual impact
	Australian humpback dolphin	No significant residual impact
Reptiles	Estuarine crocodile	No significant residual impact

MNES Group	Species	Result
Commonwealth marine environment		
	Commonwealth marine area	No significant residual impact
	Cetaceans	No significant residual impact
	Listed marine species	No significant residual impact
	Commonwealth heritage values	No significant residual impact

10. Conclusion

GEMCO proposes to construct an ocean outfall within the western portion of Groote Eylandt, Northern Territory. The placement of the Project has been designed to avoid or minimise the potential for impact to the marine environment. The Project is located within the Port limits of Milner Bay. This location was chosen as the preferred option due to the already heavily modified habitat within the Port limits, relatively low environmental value of the benthic habitats in the area, and proximity to existing activities that are already causing localised environmental disturbance.

A marine ecological assessment of the Project's footprint and Project area has been undertaken to identify potential impacts on marine ecosystems and support the Project's referral submission to the NT EPA. This report has been prepared detailing the methods and results of an ecological desktop assessment, and targeted survey activities undertaken for the GEMCO Excess Water Disposal Project.

The key findings are summarised below:

- Benthic habitat in the marine footprint and Project area is dominated by soft-substrate and is not considered to be unique within the surrounding environment.
- Seagrass, macroalgae, and coral communities are present throughout the Study area, however, these are largely absent from the construction footprint. Where seagrasses and macroalgae were identified in the survey area (beyond the construction footprint) their presence was strongly seasonal – with extensive benthic cover during summer and almost no presence during winter.
- Plume mixing zone is predicted to be vertically constrained (buoyant) and therefore will not impact benthic habitats.
- No conservation significant marine flora species were identified as having the potential to occur within the Project area.
- No marine pests or diseases are known to the Groote Eylandt archipelago.
- Twenty-seven fauna species of conservation significance were assessed as confirmed or likely to occur within the Study area.

The Project's construction and operation has the potential to result in habitat loss within disturbed areas, habitat degradation and disruption of fauna in surrounding areas and a low potential to cause fauna injury or mortality. Where proposed avoidance and mitigation measures are developed and implemented as outlined in Section 8, any potential impacts on the marine environment will be able to be minimised as low as reasonably practicable.

Potential residual impacts to marine ecosystems, particularly benthic communities, benthic habitats, and marine species have been identified and assessed in accordance with relevant guidelines.

Overall, per the assessment against the EPBC MNES Significant impact guidelines 1.1 and with the application of the identified avoidance and mitigation measures, no significant residual impacts are likely to occur. The potential for the Project to significantly impact on MNES and/or TPWC Act listed threatened species is considered unlikely. Further, the NT EPA's objectives for coastal processes, marine environmental quality and marine ecosystems will be met.

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Appendices

Appendix A

PMST Database Reports



Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 25-Oct-2024

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[Matters of NES](#)

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Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	36
Listed Migratory Species:	48

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	78
Whales and Other Cetaceans:	10
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	3

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	2
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	7
Key Ecological Features (Marine):	None
Biologically Important Areas:	3
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Chloebia gouldiae listed as Erythrura gouldiae Gouldian Finch [90091]	Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area	In feature area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat may occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat known to occur within area	In feature area
MAMMAL			
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area	In feature area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area	In feature area
Notomys aquilo Northern Hopping-mouse, Woorrentinta [123]	Endangered	Species or species habitat known to occur within area	In feature area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area	In feature area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area
Tiliqua scincoides intermedia Northern Blue-tongued Skink [89838]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Varanus mertensi Mertens' Water Monitor, Mertens's Water Monitor [1568]	Endangered	Species or species habitat known to occur within area	In feature area
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species	[Resource Information]		
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area	In feature area
Migratory Marine Species			
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Carcharias taurus Grey Nurse Shark [64469]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area	In feature area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sousa sahalensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area	In feature area
Migratory Terrestrial Species			
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area	In feature area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area	In feature area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat may occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands		[Resource Information]
The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.		
Commonwealth Land Name	State	Buffer Status
Defence		

Commonwealth Land Name	State	Buffer Status
Defence - NORFORCE DEPOT - GROOTE EYLANDT [70068]	NT	In buffer area only

Listed Marine Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area overfly marine area	In feature area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area	In feature area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area	In feature area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area	In feature area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area	In feature area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area	In feature area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area	In feature area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area	In feature area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area	In feature area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area	In feature area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area	In feature area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halicampus spirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area	In feature area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned Seadragon [66226]		Species or species habitat may occur within area	In feature area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area	In feature area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area	In feature area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area	In feature area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area	In feature area
Mammal			
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area
Reptile			
Aipysurus duboisii Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area	In feature area
Aipysurus laevis Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area	In feature area
Aipysurus mosaicus as Aipysurus eydouxii Mosaic Sea Snake [87261]		Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area	In feature area
Hydrelaps darwiniensis Port Darwin Sea Snake, Black-ringed Mangrove Sea Snake [1100]		Species or species habitat may occur within area	In feature area
Hydrophis atriceps Black-headed Sea Snake [1101]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area	In feature area
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area	In feature area
Hydrophis inornatus Plain Sea Snake [1107]		Species or species habitat may occur within area	In feature area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area	In feature area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area	In feature area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area	In feature area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area	In feature area
Hydrophis pacificus Pacific Sea Snake, Large-headed Sea Snake [1112]		Species or species habitat may occur within area	In feature area
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area	In feature area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area	In feature area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area
Parahydrophis mertoni Arafura Smooth Sea Snake, Northern Mangrove Sea Snake [1090]		Species or species habitat may occur within area	In feature area

Whales and Other Cetaceans		[Resource Information]	
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Sousa sahalensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Habitat Critical to the Survival of Marine Turtles		[Resource Information]	
Scientific Name	Behaviour	Presence	Buffer Status
Aug - Sep			
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur	In feature area
Dec - Jan			
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur	In feature area
Nov - May			
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Known to occur	In feature area

Extra Information

State and Territory Reserves		[Resource Information]	
Protected Area Name	Reserve Type	State	Buffer Status
Anindilyakwa	Indigenous Protected Area	NT	In feature area
Anindilyakwa	Indigenous Protected Area	NT	In feature area

EPBC Act Referrals		[Resource Information]		
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Winchelsea Island Manganese Mine Project, NT	2021/8877		Assessment	In buffer area only
Controlled action				
Eastern Leases Project, Groote Eylandt, Northern Territory	2014/7228	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Eastern Leases 2010 Exploration Drilling Program	2010/5455	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Acoustic and Resistivity Sub-Bottom Profiling Survey	2011/6116	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Eastern Leases 2013 Exploration Drilling Program, Groote Eylandt, NT	2013/6848	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Eastern Leases Manganese Exploration Drilling	2008/4563	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Groote Eylandt Offshore Marine Surveys	2010/5643	Referral Decision	Completed	In feature area
Biologically Important Areas				
			[Resource Information]	
Scientific Name		Behaviour	Presence	Buffer Status
Marine Turtles				
Chelonia mydas				
Green Turtle [1765]		Interesting	Likely to occur	In feature area
Eretmochelys imbricata				
Hawksbill Turtle [1766]		Interesting	Likely to occur	In feature area
Natator depressus				
Flatback Turtle [59257]		Interesting	Likely to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact us](#) page.

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Appendix B

Likelihood of occurrence assessment

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
Reptiles					
<i>Lepidochelys olivacea</i> Olive ridley turtle	PMST, NR Maps	E, Mig (marine)	V	Olive ridley turtles nesting occurs throughout tropical waters (except the Gulf of Mexico) and some subtropical areas (Pritchard 1969). Nesting occurs in nearly 60 countries worldwide, olive ridley turtles were recorded nesting in all bioregions of the Northern Territory, nesting on both mainland and on island beaches (Chatto & Baker 2008). Migratory movements are less well studied than other marine turtle species but are known to involve the coastal waters of over 80 countries. A substantial part of the immature and adult population forage over shallow benthic habitats from northern Western Australia to south-east Queensland (Harris 1994 cited in Limpus 2008).	Confirmed to occur NR Maps database contains many records of this group of species around Groote Eylandt, but none within the Study area. Majority of records were primarily records of one nesting female that was satellite tagged in 2005 for 5 months, and this female remained in the south-west extend of Groote Eylandt during this period (McMahon <i>et al.</i> , 2007).
<i>Caretta caretta</i> Loggerhead turtle	PMST, NR Maps	E, Mig (marine)	V	In Australia, loggerhead turtles nest on open, sandy beaches (Spotila 2004), small loggerhead turtles live at or near the surface of the ocean and move with the ocean currents (DCCEEW, 2023). Habitat ranging from nearshore to 55 m, loggerhead turtles choose a wide variety of tidal and sub-tidal habitat as feeding areas (Limpus 2008a) much of their feeding is done in the top 5 m of water (Spotila 2004). Loggerhead turtles migrate from southern Queensland rookeries to the Northern Territory, Torres Strait, Papua New Guinea, Solomon Islands, New Caledonia and Vanuatu (Limpus <i>et al.</i> 1992).	Confirmed to occur This species has a known presence in the Study area based on observations from previous studies and during the June 2024 field assessment. This is despite the lack of records provided in NR Maps database. This species may migrate through the area amongst suitable seagrass foraging habitat in the shallow waters. However, there are no known nesting beaches for this species in the Study area, and any individual would likely be transient.
<i>Dermochelys coriacea</i> Leatherback turtle	PMST, NR Maps	E, Mig (marine)	CE	Leatherback turtles are found in tropical to sub-polar oceans, from the North Sea and the Gulf of Alaska to the southern Pacific and Atlantic Oceans. In Australia, the leatherback turtle has been recorded feeding in coastal waters offshore of all Australian States (DEWHA, 2008). The habitat of the leatherback turtle is pelagic marine foraging areas, in tropical and in cool temperate waters, with some individuals reaching sub-polar oceans. Foraging occurs throughout the water column, from the surface layer to depths of several hundred metres. Nesting beaches are comprised of soft sand and have a shallow approach angle from the sea (DEWHA, 2008).	Likely to occur This species has been recorded in the waters around Groote Eylandt. It likely migrates through the Study area amongst suitable foraging habitat both in shallow and deeper waters. However, there are no known nesting beaches for this species in the Groote Eylandt archipelago and any individual would likely be transient.
<i>Natator depressus</i> Flatback turtle	PMST, NR Maps	V, Mig (marine)	NL	Flatback turtles are the most widely spread nesting marine turtle species in the Northern Territory (Chatto & Baker 2008), nesting on a wide variety of beach types around the entire coastline with a majority of these sites on islands. Adults inhabit soft bottom habitat over the continental shelf of northern Australia, extending into Papua New Guinea and Irian Jaya (Spring 1982; Zangerl <i>et al.</i> 1988).	Confirmed to occur Traditional owners have recorded this species in waters within Milner Bay (WSP 2023). There are also NR Maps records in and around the Study area. This species may migrate through the wider area amongst suitable seagrass foraging habitat in the shallow waters, and to move to nesting beaches on the south-western side of Groote Eylandt, and other surrounding islands.

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Chelonia mydas</i> Green turtle	PMST, NR Maps	V, Mig (marine)	NL	The North Region of Australia supports at least two different genetic breeding stocks of green turtles (Gulf of Carpentaria and North Great Barrier Reef) (Limpus & Chatto 2004; Limpus in press, as cited in DEWHA 2008). Once green turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds.	Confirmed to occur This species has a known presence in the Study area based on observations from previous studies and observations by Traditional Owners in the nearby waters of Milner Bay (WSP 2023). This is despite the lack of records provided in NR Maps database in the Study area. This species may migrate through the wider area amongst suitable seagrass foraging habitat in the shallow waters, and to move to nesting beaches on the south-western side of Groote Eylandt, and other surrounding islands.
<i>Eretmochelys imbricata</i> Hawksbill turtle	PMST, NR Maps	V, Mig (marine)	V	Once hawksbill turtles reach 30 to 40 cm curved carapace length, they settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. They primarily feed on sponges and algae (Whiting 2000a). Nesting occurs in the northern Great Barrier Reef and the Torres Strait between January and April (Dobbs <i>et al.</i> 1999; Loop <i>et al.</i> 1995); in the Northern Territory during the second half of the year (Chatto 1997, 1998).	Confirmed to occur NR Maps database contains very few records of this species around Groote Eylandt; however, it is rarer than other sea turtles in the Gulf of Carpentaria, and therefore observations are anticipated to be less frequent. Some of these records occur within the Study area, however there are no known nesting beaches in the area. It is likely that this species migrates through the wider area amongst suitable foraging habitat in the shallow waters, and to move to nesting beaches on the eastern extent of the Groote Eylandt archipelago.
<i>Crocodylus porosus</i> Estuarine crocodile	PMST, NR Maps	Mig (marine)	NL	The estuarine crocodile mostly occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland from the coast. It has been noted that evaporation in isolated channels may lead to salinity levels that are twice that of seawater. The Salt-water Crocodile usually inhabits the lower (estuarine) reaches of rivers, though overlap into the upper reaches occur in some rivers.	Confirmed to occur This species has a known presence in the Study area based on Traditional Owner knowledge (WSP, 2023) and relatively recent NR Maps records within the Study area.
<i>Hydrophinae</i> and <i>Laticaudinae</i> (sub families) Sea snakes	PMST, NR Maps	Ma		Sea snakes in Australia are primarily found in the warm, tropical waters of the northern and eastern coasts, including the Great Barrier Reef and the Timor Sea. They inhabit a variety of habitat types including the open ocean, coral reefs, mangroves, and estuaries. Sea snakes are air breathers and need to resurface approximately every 20 minutes.	May occur There are no records of this group of species in the Study area based on previous studies or NR Maps. There are however records more broadly offshore in deeper waters to the south of Groote Eylandt. This group of species generally inhabit deeper waters in the Gulf area, and therefore suitable habitat is unlikely to be present in the Study area.
Mammal					
<i>Dugong dugon</i> Dugong	PMST	Mig (marine)	NL	Dugongs occur in coastal and island waters from Shark Bay in Western Australia across the northern coastline to Moreton Bay in Queensland (Marsh <i>et al.</i> , 2002, 2011a). Dugongs spend most of their time in the neritic zone, especially near tidal and subtidal seagrass meadows. Dugongs are seagrass community specialists and their range is broadly coincident with the distribution of seagrasses in the tropical and sub-tropical waters of Australia.	Confirmed to occur There are recent and historical records of this species in the Study area based on previous studies (Marsh <i>et al.</i> 2008, Groom <i>et al.</i> 2017) and NR Maps. Although there is low quality habitat (sparse seagrass) in the Study area, dugongs may still utilise this habitat for short periods of time, or whilst in transit to higher quality feeding grounds located elsewhere around Groote Eylandt (e.g. south of Port Limits).

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Balaenoptera edeni</i> Bryde's Whale	PMST	Mig (marine)	NL	Bryde's whales occur in temperate to tropical waters, both oceanic and inshore and have been recorded from all Australian states and in the northern territory. Insufficient information exists as to how Australian Bryde's whales use their habitat, as no specific feeding or breeding grounds have been discovered off Australia. Globally, the smaller inshore form of the species is often resident in waters containing suitable prey stocks of pelagic shoaling fishes, while the offshore form appears to undergo extensive migrations between subtropical and tropical waters during the winter months (Best 1977).	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species typically occurs in deeper waters and would be unlikely to occur inshore near the Study area.
<i>Balaenoptera musculus</i> Blue Whale	PMST	E, Mig (marine)	NL	Much of the Australian continental shelf and coastal waters have no particular significance to the whales and are used only for migration and opportunistic feeding. Feeding areas are located around the southern continental shelf, notably the Perth Canyon, Western Australia, and the Bonney Upwelling and adjacent upwelling areas of South Australia and Victoria (DEH, 2005). One pygmy blue whale was recorded in eastern Gulf of Carpentaria in 2020 (Queensland Government, unpublished data) but it was assumed to be outside of the normal range of the species.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species prefers deeper waters and there is no suitable deep-water habitat in the Study area.
<i>Delphinus depphis</i> Common dolphin	PMST	Cetacean	NL	This species has broad distribution in offshore waters around Australia, though are rarely seen in northern Australian waters. They occur mainly in medium water depths over the continental shelf, in areas inhabited by small epipelagic fishes such as anchovies and sardines.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species typically occurs in deeper, cooler waters and would be unlikely occur in warmer, shallow waters in the Study area.
<i>Orcinus orca</i> Orca	PMST	Mig (marine)	NL	Orcas are recorded from all states, with concentrations reported around Tasmania. Sightings are also frequent in South Australia and Victoria (Ling 1991). A sighting at Yirrkala in April 1999 provides evidence that they also occur in Northern Territory waters (Chatto & Warneke 2000). Orca are known to occur in the Gulf of Carpentaria, but are thought to range over large areas and are likely to be infrequent in the Study area.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species prefers deeper waters and there is no suitable deep-water habitat in the Study area.
<i>Orcaella heinsohni</i> Australian snubfin dolphin	PMST	Mig (marine)	NL	Australian snubfin dolphins occur only in waters off the northern half of Australia, from approximately Broome on the west coast to the Fitzroy River on the east coast (Parra <i>et al.</i> 2002a). Surveys indicate that Australian snubfin dolphins occur mostly in protected shallow waters close to the coast, and close to river and creek mouths (Parra 2006; Parra & Corkeron 2001; Parra <i>et al.</i> 2002a). Within Australia, Australian snubfin dolphins are mostly recorded in coastal and estuarine waters.	Confirmed to occur There are relatively recent records of this species in the Study area based on previous studies (Groom <i>et al.</i> 2017) and NR Maps.
<i>Grampus griseus</i> Risso's Dolphin	PMST	Cetacean	NL	In Australia, Risso's Dolphins have been recorded from all states except Tasmania and the Northern Territory (Bannister <i>et al.</i> 1996; Ross 2006). Stranding records range from about 23° S to 39° S, although there is at least one stranding from further north, on Croker Island in the Northern Territory (NT Government 2013). Risso's Dolphin occur mainly on steep sections of the upper continental slope (Baumgartner 1997), usually in waters deeper than 1000 m (Ross 1984), in tropical and warm temperate latitudes.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species typically occurs in deeper waters off the continental shelf and would be unlikely to occur inshore near the Study area.

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Sousa sahalensis</i> Australian Humpback dolphin	PMST	Mig (marine)	NL	Australian humpback dolphins are found in tropical/subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea (Jefferson and Rosenbaum, 2014). In Australia, humpback dolphins are thought to be widely distributed along the northern Australian coastline from approximately the Queensland–New South Wales border to western Shark Bay, Western Australia (Parra & Cagnazzi 2016). Australian humpback dolphins are found primarily in coastal waters (Parra & Cagnazzi 2016). In Queensland and in the Northern Territory, Australian humpback dolphins have been recorded mostly within 10 km of the coast (Palmer <i>et al.</i> , 2014b; Parra <i>et al.</i> , 2004, 2006b, all cited in Parra & Cagnazzi 2016).	Confirmed to occur There are relatively recent NR Maps records of this species in the Study area. Suitable habitat is present for this species in the form of coastal waters. This species likely uses the area transiently for foraging or protection.
<i>Pseudorca crassiden</i> False killer whale	NT Gov data (Palmer <i>et al.</i> 2023)	Cetacean	NL	False killer whales are often recorded throughout the Gulf of Carpentaria, and recent genetic and satellite tracking data suggests that a resident population of the species occurs in the Study area (Palmer <i>et al.</i> 2023).	Confirmed to occur There are relatively recent records of this species in the Study area based on previous studies (Palmer <i>et al.</i> 2023) and NR Maps. This species likely uses the area transiently when seeking prey before returning to deeper waters.
<i>Stenella longirostris</i> Spinner dolphin	NT and Qld Gov data (unpublished)	Cetacean	NL	The smaller subspecies of spinner dolphin, the dwarf spinner dolphin, <i>Stenella longirostris rosiventris</i> is reported to occur throughout inshore areas of the Gulf of Carpentaria and around islands in the Northern Territory (Allen 2021). Distribution and habitat requirements for this species is not well known in Australia.	May occur There are no records of this species in the Study area based on NR Maps. There are reports of a subspecies occurring in tropical in shore waters of the Gulf of Carpentaria (Allen 2021), however the locations of these sightings are not confirmed.
<i>Stenella attenuate</i> Pantropical spotted dolphin	PMST	Cetacean	NL	This species occurs in both near-shore and ocean habitats in tropical and warm temperate seas. They are found along the continental shelf and slope indicating potential use of neritic habitat.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. This species typically occurs in deeper waters off the continental shelf and would be unlikely to occur inshore in the Study area
<i>Tursiops aduncus</i> Indian ocean bottlenose dolphin	PMST, NR Maps	Cetacean	NL	This species is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands.	Confirmed to occur There are relatively recent records of this species in the Study area based on NR Maps. Suitable habitat is present for this species.
<i>Tursiops truncatus</i> Bottlenose dolphin	PMST, NR Maps	Cetacean	NL	Distribution for this species is not well known in Australia, but they are found in all temperate and tropical waters around the world. In Australia this species tends to inhabit offshore waters, but they can inhabit coastal shores. They can tolerate a broad range of habitat types.	May occur There are no records of this species in the Study area based on previous studies or NR Maps. Although there are records of this species around Groote Eylandt, this species typically occurs in deeper waters and would be unlikely to occur inshore in shallower waters near the Study area. There is no suitable habitat in the Study area for this species.
Fish					

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Syngnathidae</i> 12 species of seahorses and pipefishes	PMST	Marine		Syngnathids inhabit a variety of habitats, including seagrass meadows, coral reefs, mangroves, macrophytes, and artificial structures in tropical and temperate coastal waters around the world (Froese and Pauly, 2020). Species within the Syngnathidae family have distinct characteristics such as differing distribution and relative abundance patterns across the North Marine Region, ranging from rare to very common (CoA, 2012). Habitat that supports syngnathid populations is generally patchy, so populations of syngnathid species may be dispersed and fragmented (CoA, 2012). Most species generally display a preference for seagrass and macroalgal beds, coral reefs, mangroves and sponge gardens (CoA, 2012). Although certain species are also found in open sandy or muddy bottoms and estuaries and lagoons (Lourie <i>et al.</i>, 2004).	Likely to occur This group of species was not recorded during recent field surveys or studies, and there is relatively low quality habitat in the Construction footprint (lack of complexity) for this group of species. These species are cryptic and therefore are assumed to be present as suitable habitat is present in the broader Study area. NR Maps database contains no recent records of this group of species across Groote Eylandt archipelago. The closest records are two older (1998) records of this group of species ~ 20 km north-west of Milner Bay.
Elasmobranchs					
<i>Pristis pristis</i> Northern sawfish	PMST	V, Mig (marine)	V	The Northern Sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River, Western Australia, to the western side of Cape York Peninsula, Queensland. This is a marine/estuarine species that occur in fresh or weakly saline water (Last & Stevens 1994). In northern Australia, this species appears to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km from the sea (Thorburn <i>et al.</i> 2007; Whitty <i>et al.</i> 2008). The preferred habitat of this species is mud bottoms of river embayments and estuaries, but they are also found well upstream (Allen 1997). They are not found near riparian vegetation (Wilson 1999). They are usually found in turbid channels of large rivers over soft mud bottoms (Allen 1991) more than 1 m deep, but they will move into shallow waters when travelling upstream or while hunting prey (Wilson 1999).	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. There is also no suitable habitat in the Study area for this species (freshwaters and weakly saline waters not present).
<i>Carcharodon carcharias</i> Great White Shark	PMST	V, Mig (marine)	NL	Great White Sharks have been recorded from central Queensland around the south coast to north-west Western Australia, but may occur further north on both coasts (Bonfil <i>et al.</i> 2005; Bruce <i>et al.</i> 2006; Last & Stevens 2009; Paterson 1990). It has been sighted in all coastal areas except in the Northern Territory. Although capable of crossing ocean basins, the species is typically found from close inshore habitats (e.g. rocky reefs and shallow coastal bays) to the outer continental shelf and slope areas.	May occur There are no records of this species in the Study area based on previous studies or NR Maps. While there is suitable habitat for this species, there are no known records in the wider region and therefore this species is unlikely to be frequent visitors of the inshore waters.

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Rhincodon typus</i> Whale shark	PMST	V, Mig (marine)	NL	The Whale Shark is known from NSW, Queensland, Northern Territory, Western Australia and occasionally Victoria and South Australia, but it is most commonly seen in waters off northern Western Australia, Northern Territory and Queensland (Compagno 1984; Last & Stevens 1994). Ningaloo Reef, off the Western Australian coast, is the main known aggregation site of Whale Sharks in Australian waters. Taylor (1996) suggests that this aggregation is due to seasonal concentrations of krill and other zooplankton, which are a food source for the Whale Shark. The Whale Shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore, but also comes close inshore and sometimes enters lagoons of coral atolls. The Whale Shark is generally encountered close to or at the surface, in areas where the surface temperature is 21–25 °C, preferably with cold water of 17 °C or less upwelling into it, and salinity of 34 to 34.5 parts per thousand (ppt) (Pogonoski <i>et al.</i> 2002).	May occur There is one record of this species near the Study area. This species typically occurs in deeper waters and would be unlikely to occur inshore where there is less suitable habitat (no deep upwellings or known seasonal aggregations of plankton) but it may transit through migrating to deep water habitats surrounding the island.
<i>Pristis zijsron</i> Green Sawfish	PMST	V, Mig (marine)	V	Green Sawfish have historically been recorded in the coastal waters off Broome, Western Australia, around northern Australia and down the east coast as far as Jervis Bay, NSW (Stevens <i>et al.</i> 2005). Green sawfish are currently distributed from about the Whitsundays (Harry <i>et al.</i> , 2011) in Queensland across northern Australian waters to Shark Bay in Western Australia. Individuals have been recorded in inshore coastal environments and estuaries but the species does not penetrate into freshwater. The green sawfish inhabits muddy bottom habitats and enters estuaries (Allen 1997; Stead 1963). It has been recorded in inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches (Peverell <i>et al.</i> 2004; Stevens <i>et al.</i> 2005; Thorburn <i>et al.</i> 2004).	Likely to occur This species does not have recent records from previous studies or NR Maps, however there are historical records in the broader area and suitable habitat for this species in the form of inshore marine waters (sandy, muddy benthos); however, all other preferred habitats are limited or absent.
<i>Pristis clavata</i> Dwarf Sawfish	PMST	V, Mig (marine)	V	The Dwarf Sawfish has been identified to occur from the western coast of Cape York Peninsula (TSSC 2009bm). Previously it was considered to extend north from Cairns around the Cape York Peninsula in Queensland, across northern Australian waters to the Pilbara coast in Western Australia (Last & Stevens 1994; McAuley <i>et al.</i> 2005; Stevens <i>et al.</i> 2008). The Dwarf Sawfish usually inhabits shallow (2–3 m) coastal waters and estuarine habitats and does not utilise any purely freshwater areas, as the species' range is restricted to brackish and salt water (Thorburn <i>et al.</i> 2007a).	May occur There are no records of this species in the Study area based on previous studies or NR Maps. There is some suitable habitat in the Study area for this species, but this is not quite as shallow as the preferred habitat range, and there are no estuarine habitats.
<i>Anoxypristis cuspidate</i> Narrow Sawfish	PMST, NR Maps	Mig (marine)	NL	The Narrow Sawfish moves readily between fresh and brackish or marine waters. In Australia, it is found across northern Australia from the Pilbara Coast (Western Australia) to Broad Sound (Queensland) (Last and Stevens, 2009). The Narrow Sawfish is a benthic-pelagic species that inhabits coastal and estuarine habitats. It occurs at depths of at least 40 m (Last and Stevens, 2009). Adults mainly occur offshore while juveniles and pupping females require inshore and estuarine habitats (Peverell, 2005).	Likely to occur This species does not have recent records from previous studies or NR Maps, however there are historical records in the broader area and there is suitable habitat (sandy, muddy benthos) present in the Study area. There is also suitable breeding habitat for this species in the form of inshore marine coastal waters. Deeper waters (>20 m) are not present.

Species	Source	Conservation status		Distribution and habitat requirements	Likelihood of occurrence
		EPBC Act	TPWC Act		
<i>Glyphis glyphis</i> Speartooth Shark	PMST	CE	V	The Speartooth Shark has been recorded in tidal rivers and estuaries within the Northern Territory and Queensland. Within the Northern Territory the Speartooth Shark has been recorded in the Adelaide River, South, East and West Alligator Rivers, Murganella Creek and Marrakai Creek. In Queensland the Speartooth Shark has been found in the Wenlock and Ducie Rivers, Port Musgrave (the mouth of these two rivers) and the Bizant River (Stevens <i>et al.</i> 2005). The Speartooth Shark has only been captured in tidal rivers and estuaries indicating that large tropical river systems appear to be the primary habitat for this shark (Stevens <i>et al.</i> 2005). It is inferred that this species may be largely restricted to low salinity environments such as freshwater and brackish areas of rivers (Pillans <i>et al.</i> 2005; Pogonoski & Pollard 2003).	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. There is also no suitable habitat for this species present within the Study area, namely tidal rivers and estuaries.
<i>Sphyrna lewini</i> Scalloped Hammerhead	PMST	CD	NL	The Scalloped Hammerhead is recorded around the northern coastline, with ranges extending down to Sydney along the eastern coastline and Geographe Bay along the western coastline (Last and Stevens, 2009). The species inhabits continental and insular shelves and adjacent deep water from the surface and intertidal areas to at least 275 m depth (Compagno, 1984; Ebert <i>et al.</i> , 2021).	Likely to occur There are records of this species around Groote Eylandt, and this species is highly mobile with suitable habitat (coastal waters) present around the Study area. This species prefers shallow coastal waters and are likely to transit through the area.
<i>Mobula alfredi</i> Reef Manta Ray	PMST	Mig (marine)	NL	Known on Australian waters from about Perth, Western Australia, around the tropical north to at least Sydney, New South Wales; also Cocos (Keeling) Islands and Christmas Island in the eastern Indian Ocean. Although Manta Rays are often seen inshore around coral and rocky reefs in tropical and subtropical waters, they also occur around offshore reefs and seamounts (Bray, 2020).	May occur There are no records of this species in the Study area based on previous studies or NR Maps. There is also only poor quality habitat available (limited inshore coral in shallow environment). Any individual passing through the area are likely transient.
<i>Mobula birostris</i> Giant Manta Ray	PMST	Mig (marine)	NL	The Giant Manta Ray lives in tropical, marine waters worldwide, but is also found occasionally in temperate seas. In Australia it is recorded from south-western Western Australia, around the tropical north of the country and south to the southern coast of New South Wales.	Unlikely to occur There are no records of this species in the Study area based on previous studies or NR Maps. There is also no suitable habitat in the Study area for this species (shallow, coastal, no upwelling).

Appendix C

MNES Significant Impact Assessment

Approach

For each MNES that was confirmed or likely to occur in the Study area, a significance of impact assessment was undertaken using the Commonwealth *Significant impact guidelines 1.1* (Department of the Environment (DoE), 2013) as described in Section 4.3. In all significance of impact assessments, consideration was given to the intensity, duration, cumulative impact, irreversibility and the risk of environmental harm. The assessment is based on residual risk after all identified mitigation measures have been applied.

Commonwealth marine area

Commonwealth marine areas (CMAs) are protected under the EPBC Act and are any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not state or Northern Territory waters. CMAs stretch from 3 up to 200 nautical miles from the coast. Groote Eylandt is located within Northern Territory waters; however, CMAs are located off the southern and eastern coasts of the island. As per the *Matters of National Environmental Significance Significant impact guidelines 1.1* (DoE, 2013), an action will require approval if the action is taken outside a CMA and the action has, will have, or is likely to have a significant impact on the environment in a CMA. This includes any other matters protected by the EPBC Act (i.e. animals listed as marine species or whales and other cetaceans) that relate the CMAs but are not listed as threatened.

To determine if the Project is likely to have a significant impact the CMA, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 19 The significant impact assessment is based on the extent of impact to the CMA.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the CMA is not considered likely to occur.

Table 19 Significant impact assessment – CMA

An action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will:	Assessment
Result in a known or potential pest species becoming established in the Commonwealth marine area	Not likely The proposed works occur within Northern Territory waters as defined by the <i>Coastal Waters (State and Northern Territory Powers) Act 1980</i> and are > 30 km from a Commonwealth marine area. The residual risk of introducing a pest species into a Commonwealth marine area is considered unlikely, given the mitigations and procedures in place (Section 8). The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a CMA result	Not likely The areas that may be impacted by the Project comprise open sand habitat with the presence of macroinvertebrate fauna. Areas of limited habitat have been selected to avoid any sensitive areas, such as coral reefs and seagrass meadows, and are > 30 km from a Commonwealth marine area. While there may be some indirect, minor impacts due to changes in water quality, these are unlikely to reach any CMAs outside of the Project footprint.

An action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will:	Assessment
Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution	Not likely There are several marine species, including cetaceans, that are known to occur in Milner Bay and around the port area. There is no suitable foraging (i.e. dense seagrass meadows) or breeding habitats within the areas surveyed or identified in any previous studies or field surveys. The area is mapped as interesting habitat for two of the marine turtle species, but there are no nesting beaches in the Project area. Except for dolphins and false killer whales, marine species that have been recorded are isolated individuals migrating through the area. Schools of dolphins have been recorded foraging in the port around the wharf; however, they only remained in the area for approximately 1 hour before migrating to other areas (Arup, 2022). Satellite tracking by researchers in the Northern Territory government suggests that false killer whale is likely to occur in the Project area and that these animals may be residents across the broader area (Palmer <i>et al</i>, 2023). The size of the population is not known. All species previously recorded were during normal operations of the port when barges and vessels were in the area. The current Project may increase the number of vessels using the Port but this is unlikely to be significant increase and will only be temporary during construction. Marine fauna species are likely to still migrate through the area on occasion consistent with normal operations of the port. To mitigate impacts to marine and cetacean species listed under the EPBC Act, vessels in the vicinity of cetaceans shall operate in accordance with the Australian the National Guidelines for Whale and Dolphin Watching 2017 (as legislated in Commonwealth waters by Section 8 of the EPBC Act Regulations 2000) and the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017. With recommended mitigation measures (Table 15), impacts from noise can be reduced so that marine species are unlikely to be affected. Additionally, most species will avoid the area once any noise commences. Overall, the Project is unlikely to have a substantial adverse effect on a population of a marine species or cetaceans including its life cycle and spatial distribution.
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health	Not likely Significant adverse impacts on air quality are not expected from the Project. Potential impacts on water quality will be managed by continuation of the long-term marine water quality monitoring program to identify long-term impacts from the marine discharge on water quality or the marine environment. Therefore, the Project has been assessed as unlikely to result in a substantial change in air quality or water quality (including temperature), which may adversely impact on biodiversity, ecological integrity; social amenity or human health.
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected,	Not likely Residual risk of harmful pollutants is likely to be low, given mitigations for potential impacts during the construction phase (Table 15) and operation phase (Table 16). Potential impacts on water quality will be managed by continuation of the long-term marine water quality monitoring program to identify long-term impacts from the marine discharge on water quality or the marine environment.
Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.	Not likely The proposed works occur with Northern Territory waters and are > 30 km from a Commonwealth marine area. There are no heritage values identified within the EPBC Act PMST search tool. No heritage values were recorded during field surveys (Appendix B). No other cultural values were identified in consultation with Senior Bara/Jaragba TOs. Therefore, the Project will not have an adverse impact on heritage values of the CMA.

Loggerhead turtle

Biology and ecology

Loggerhead turtles are listed as endangered and migratory under the EPBC Act, and vulnerable under the TPWC Act. Loggerhead turtles forage on benthic habitats, such as rocky and coral reefs, seagrass meadows and sandflats; however, spend most of their time foraging in the open ocean on planktonic organisms (Limpus *et al.*, 1994). Loggerhead turtles spend their first 15 years in the open ocean (DCCEEW, 2024b) and then migrate to inshore areas where they show site fidelity to both their foraging and breeding areas (Limpus 2008a).

Occurrence and habitat

Loggerhead turtles were recently recorded during the benthic habitat surveys for the Project in June 2024. The individual was breathing at the surface, migrating through the area. This species is frequently recorded in the region (NR Maps, 2024).

In Australia, loggerhead turtles nest on open, sandy beaches. Hatchlings enter the open ocean and begin feeding on small animals where they live at or near the surface of the ocean and move with the ocean currents (DCCEEW, 2024b). Loggerhead turtles choose a wide variety of tidal and sub-tidal habitat as feeding areas and show fidelity to both their foraging and breeding areas (Limpus 2009). When ready for breeding, mature turtles migrate to their chosen breeding area and once breeding and nesting is complete, turtles return to their favoured foraging areas (DCCEEW, 2024b).

Hatchling to subadult loggerheads occur in the open ocean foraging on planktonic organisms (Limpus *et al.*, 1994).

There is suitable migration habitat identified within the Study area for this species and while there is suitable nesting habitat in the form of sandy beaches on the island, Groote Eylandt is not a known rookery.

Important populations

There are no important populations described for loggerhead turtles in the *Recovery Plan for Marine Turtles* (DEE, 2017a). Therefore, the local population is not considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Nesting and internesting habitat have been identified for each stock. For loggerhead turtles, this includes at least 70 per cent of nesting for the stock, which occurs along three major areas in Queensland:

- Mon Repos
- Thirteen islands of the Capricornia-Bunker groups
- Islands of the Swain Reefs (DCCEEW, 2024b).

There are no known significant nesting beaches in the NT. Additional habitat critical to the survival for the species includes (DEE, 2017a):

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Nesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The habitat critical buffer for loggerhead is 20 km.

Overall, there is no habitat critical to the survival in the Study area.

Nature and extent of impact

The nature of potential impacts to loggerhead turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions

- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Loggerhead turtles face a number of threats associated with the following broad categories of human activity:

- Commercial and recreational fishing
- Coastal infrastructure and development (including industrial, residential and tourism development)
- Indigenous harvest
- Feral animal predation of nests
- Climate change.

The pipeline corridor being installed for the Project would not be considered a threat to loggerhead turtles, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on loggerhead turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 20. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the endangered loggerhead turtle is not considered likely to occur.

Table 20 Significant impact assessment – Loggerhead turtles

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of a population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter loggerhead turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in a temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of loggerhead turtle populations.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Reduce the area of occupancy of the species	Not likely Loggerhead turtles only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing population into two or more populations	Not likely Loggerhead turtles are pelagic and migratory occurring along the entire coast of Australia and in the open ocean. Loggerhead turtles currently co-exist around the existing port with an individual recorded during the recent (June 2024) marine habitat mapping surveys, when recreational boats and supply barges were operating at the wharf. The Project does not introduce any barriers in the marine environment that would permanently segregate areas of the open ocean so that individuals could not interact. Additionally, turtles are able to move around the surrounding open ocean waters to access more suitable habitats. The construction and operation are unlikely to fragment existing populations into two or more populations.
Adversely affect habitat critical to the survival of a species	Not likely There is no habitat critical to the survival for loggerhead turtles in the Project area, as these areas all occur on the east coast of Queensland (DCCEEW, 2024b). There is additionally no identified BIAs for this species in the Project area. While a small, temporary reduction of open sandy seabed habitat (<1.84 ha) will occur from installation of the pipeline, this habitat is not considered to be of high quality/importance for these species. Therefore, the Project will not have an adverse effect on habitat critical for survival of this species.
Disrupt the breeding cycle of a population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of the loggerhead turtles. There are no known breeding grounds in the vicinity of the Project area as all nesting for this species typically occurs on the east coast of Queensland or along Western Australian beaches (DCCEEW, 2024b). The new infrastructure will not be a barrier to movement and still allow fauna passage throughout the open ocean and access to inshore beaches. The Project is not likely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be destroyed from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.
Interfere with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017a) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current <i>Oil Spill Contingency Plan</i> (2022). Operation is unlikely to have direct or indirect impact on loggerhead turtles or their habitat with mitigation measures in place. No impact will occur to the surrounding marine environment or any loggerhead turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. Loggerhead turtles demonstrate strong site fidelity to foraging grounds; however, there are no suitable foraging ground in the area and therefore there will be no impacts to this species. With identified mitigation measures in place, the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Olive ridley turtle

Biology and ecology

Olive ridley turtles are listed as endangered and migratory under the EPBC Act, and vulnerable under the TPWC Act. Olive ridley turtles forage on shallow benthic habitats predominantly coral reefs and seagrass meadows (Limpus 2008) for molluscs. This species has similar migratory behaviour to other marine turtles, with journeys of up to 2600 km recorded for tagged individuals (Beavers & Cassano 1996); however, individuals have been known to have established home ranges (Whiting et al. 2005). No concentrated nesting has been found in Australia, although low density nesting occurs along the Arnhem Land coast of the NT (DCCEEW, 2024b).

Occurrence and habitat

There are no records of olive ridley turtles in Milner Bay, with the majority of records along the south-eastern beaches of Groote Eylandt (NR Maps, 2024). There is suitable migration habitat identified within the Project area for this species and while there is suitable nesting habitat in the form of sandy beaches they are not known to nest on the western beaches of Groote Eylandt. Female olive ridley turtles lay clutches of eggs on sandy beaches where hatchlings disperse into offshore currents and have a pelagic phase of unknown length (Musick & Limpus 1997). Small juveniles through to adults reside in coastal zones along the northern coast of Australia and historical by-catch data indicates that large immature and adult-sized turtles are present all year round over soft bottomed habits of northern Australian continental shelf waters (Musick & Limpus 1997).

Important populations

There are no important populations described for olive ridley turtles in the *Recovery Plan for Matine Turtles* (DEE, 2017B). Therefore, the local population is not considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Olive ridley turtle stocks in Australia are small and likely to be historically impacted by egg loss. Nesting habitat critical to the survival of this species includes all documented nesting areas in Queensland and Western Australia, and beaches where nesting has been recorded with greater than ten nesting females in the NT (DEE, 2017a)

There are no known major nesting beaches on Groote Eylandt, with major nesting in the NT occurring on English Company, Wessel, Crocodile, Elcho and Tiwi Islands of north-east Arnhem Land and Grant Islands, McCluer Island Group, Cobourg Peninsula, Melville Island and Bathurst Island off north-western Arnhem Land (Limpus 2009).

Additional habitat critical to the survival for the species includes (DEE, 2017a):

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Nesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The habitat critical buffer for olive ridley turtles is 20 km.

Overall, there is no habitat critical to the survival in the Project area.

Nature and extent of impact

Potential impacts to olive ridley turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Olive ridley turtles face a number of threats associated with the following broad categories of human activity:

- Commercial and recreational fishing
- Coastal infrastructure and development (including industrial, residential and tourism development)
- Indigenous harvest
- Feral animal predation of nests
- Climate change.

The pipeline corridor being installed for the Project would not be considered a threat to flatback turtles, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on olive ridley turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 21.

The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the endangered olive ridley turtle is not considered likely to occur.

Table 21 Significant impact assessment – Olive ridley turtles

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of a population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter olive ridley turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in a temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of olive ridley turtle populations.
Reduce the area of occupancy of the species	Not likely Olive ridley turtles only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time, with majority of nestling located elsewhere in the Gulf of Carpentaria. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing population into two or more populations	Not likely Olive ridley turtle stocks in Australia are small and satellite tracking data indicates that they appear to remain on the Australian continental shelf into waters off Indonesia (DEE, 2017b). Olive ridley turtles that do occur, would currently co-exist around the existing port; however, there are no records of this species in Milner Bay. The Project does not introduce any barriers in the marine environment that would permanently segregate areas of the open ocean so that individuals could not interact. Additionally, turtles are able to move around the surrounding open ocean waters to access more suitable habitats. The construction and operation are unlikely to fragment existing populations into two or more populations.
Adversely affect habitat critical to the survival of a species	Not likely Habitat critical to the survival of olive ridley turtles in the NT includes beaches where nesting has been recorded with greater than ten nesting females (DEE, 2017b). While nesting occurs in the Groote Eylandt archipelago, nesting does not occur in the Project area. The Project area is not habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of the olive ridley turtles. There are no known breeding grounds in the vicinity of the Project area and Groote Eylandt was not identified as a significant area for olive ridley turtle nesting (Chatto & Baker 2008). The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean. The Project is unlikely to disrupt the breeding cycle of the species.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be destroyed from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.
Interfere with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current Oil Spill Contingency Plan. Operation is unlikely to have direct or indirect impact on olive ridley turtles or their habitat with mitigation measures in place. No impact will occur to the surrounding marine environment or any olive ridley turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. Olive ridley turtles do not demonstrate strong site fidelity to foraging or migration grounds and there are no suitable foraging habitats in the area and therefore there will be no impacts to this species. Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Leatherback turtle

Biology and ecology

Leatherback turtles are listed as endangered and migratory under the EPBC Act, and critically endangered under the TPWC Act. Leatherback turtles forage on gelatinous organisms, such as jellyfish and salps, which typically drift in open ocean waters (DCCEEW, 2024b). Leatherback turtles have a number of physiological adaptations that allow them to maintain elevated body temperatures in cold water and avoid overheating in warmer water, including low metabolic rate, large thermal inertia, blood flow adjustments and peripheral insulation (Houghton et al. 2008).

Occurrence and habitat

There are no records of leatherback turtles in Milner Bay and only one record of the eastern coast of Groote Eylandt (ALA, 2024). Leatherback turtles are a highly pelagic species and only come to shore for nesting (Sarti Martinez 2000). This species is known from waters all around Australia and can be found foraging year-round in Australian waters over Australian continental shelf waters (DCCEEW, 2024b). Adults feed mainly on pelagic soft-bodied creatures and turtle populations occur in greatest concentrations at the surface in areas of upwelling or convergence of these species, especially jellyfish (Houghton *et al.*, 2006). There are no upwelling areas known around Groote Eylandt and the habitat of Milner Bay is not ideal pelagic open ocean waters.

Important populations

There are no important populations described for leatherback turtles in the *Recovery Plan for Marine Turtles* (DEE, 2017a). Therefore, the any leatherback turtles present in the region would not be considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Nesting and internesting habitat have been identified for each stock. For leatherback turtles this includes:

- Nesting habitat critical to the survival of individuals includes all areas where nesting has occurred in Australia since 1996.

There are no known significant nesting beaches in the NT. Additional habitat critical to the survival for the species includes (DEE, 2017a):

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Nesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The habitat critical buffer for leatherback turtles is 20 km.

There are nesting sites at Cobourg Peninsula, Manangrida and Croker Island in the NT (Chatto 1998) though the only confirmed nesting of leatherback turtles during Chatto and Baker's (2008) survey between 1991 and 2004 was at Danger Point, Cobourg Peninsula. Overall, there is no habitat critical to the survival in the Project area.

Nature and extent of impact

Potential impacts to leatherback turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Due to the low incidence of leatherback turtle nesting on Australian beaches, and their pelagic foraging habits, a number of threats faced by other marine turtles (e.g. coastal infrastructure and development, feral animal predation and Indigenous harvest) are not significant threats to leatherback turtles in Australian waters (DCCEEW, 2024b). The main threats faced by Leatherback Turtles in Australia arise from accidental catch or entanglement in commercial fishing operations (Hamann *et al.* 2006).

No other key threats are relevant to the proposed Project and therefore the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on leatherback turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 22. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the endangered leatherback turtle is not considered likely to occur.

Table 22 *Significant impact assessment – Leatherback turtles*

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of a population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter leatherback turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in a temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of leatherback turtle populations.
Reduce the area of occupancy of the species	Not likely Leatherback turtles may only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. There are no records of this species in Milner Bay and the open ocean areas adjacent to the Project area would not be considered their preferred deep water pelagic habitat. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing population into two or more populations	Not likely Leatherback turtles are pelagic and migratory occurring along the entire coast of Australia and in the open ocean. Leatherback turtles currently co-exist around the existing port and activities prior to the cyclone damage. The Project does not introduce any barriers in the marine environment that would permanently segregate areas of the open ocean so that individuals could not interact. Additionally, turtles are able to move around the surrounding open ocean waters to access more suitable habitats. The construction and operation are unlikely to fragment existing populations into two or more populations.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	Assessment
Adversely affect habitat critical to the survival of a species	Not likely There is no habitat critical to the survival for leatherback turtles, as these areas have been identified as all areas where nesting has occurred in Australia since 1996. No nesting has occurred on Groote Eylandt or islands in the archipelago. Therefore, the Project area is not habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of the leatherback turtles. There are no known breeding grounds in the vicinity of the Project area or in Australia. The new infrastructure will be a minimal barrier to movement in shallow waters only and still allow fauna passage throughout the open ocean. The Project is unlikely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be destroyed from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.
Interfere with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017a) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current Oil Spill Contingency Plan. Operation is unlikely to have direct or indirect impact on leatherback turtles or their habitat with mitigation measures in place. No impact will occur to the surrounding marine environment or any leatherback turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. Leatherback turtles generally remain in the open ocean other than when coming inshore to nest and there are no suitable foraging grounds in the area and therefore there will be no impacts to this species. Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Green turtle

Biology and ecology

Green turtles are listed as vulnerable and migratory under the EPBC Act and is not listed as a threatened species under the TPWC Act. Green turtles forage on benthic habitats, such as rocky and coral reefs, and seagrass and algae meadows (DCCEEW, 2024b). Green turtles can migrate more than 2600 km between foraging and nesting areas and often spend the first five to ten years drifting on ocean currents in the pelagic zones (DCCEEW, 2024b).

Occurrence and habitat

There are no individuals recently (i.e. within the past 10 years) recorded within Milner Bay (NR Maps, 2024; DEPWS, 2024) and no older records within 10 km of the Project area. The majority of records are from the southern and eastern beaches of Groote Eylandt. Green turtle suitable habitat has been identified as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds (DCCEEW, 2024b). There is predominantly open sandy seabed and sparse macroalgae habitat for this species and while there is suitable nesting habitat in the form of sandy beaches on the island, Groote Eylandt is not a known rookery.

Important populations

There are no important populations described for green turtles in the *Recovery Plan for Marine Turtles* (DEE, 2017a). Therefore, the local population is not considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Nesting and internesting habitat have been identified for each stock. For green turtles, this includes at least 70 per cent of nesting for the stock. The key nesting areas for green turtles are:

- Capricorn and Bunker Island Groups, Queensland
- Raine Island, Queensland
- Curtis Island and Facing Island, Queensland
- Russel Island and Scott Reef, Queensland
- Wellesley Islands, Queensland (Gulf of Carpentaria)
- Milman Islet and Boydong Islands, Queensland
- Mon Repos, Queensland
- Murray Islands, Torres Strait
- Darnley Island, Torres Strait
- Bramble Cay, Torres Strait
- Western Cape York Peninsula, Queensland (Gulf of Carpentaria)
- Pisonia Island, Queensland (Gulf of Carpentaria)
- North and South Bountiful Islands, Queensland (Gulf of Carpentaria)

Additional habitat critical to the survival for these species includes:

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Internesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The internesting habitat critical buffer for green turtles is 20 km.

Overall, there is no habitat critical to the survival in the Project area.

Nature and extent of impact

Potential impacts to green turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration

- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Green turtles face a number of threats associated with the following broad categories of human activity:

- Disturbance and habitat damage due to coastal development
- By-catch from fisheries and shark control measures
- Predation on nests
- Boat strikes
- Entanglement and ingestion of marine debris
- Indigenous harvesting
- Climate change.

The pipeline corridor being installed for the Project would not be considered a threat to green turtles, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on green turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in . The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the vulnerable green turtle is not considered likely to occur.

Table 23 Significant impact assessment – Green turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of an important population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter green turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of green turtle populations.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Reduce the area of occupancy of an important population	Not likely Green turtles only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing important population into two or more populations	Not likely There are no important populations of green turtles on Groote Eylandt. This species is predominantly pelagic and migratory occurring along the entire coast of Australia and in the open ocean. There are no permanent populations in Milner Bay and no recent records of individuals to indicate they aggregate in the area. Green turtles currently co-exist around the existing port with an individual recorded during the recent (October 2024) marine habitat mapping surveys, when recreational boats and supply barges were operating in the wharf. The Project does not introduce any barriers in the marine environment that would permanently segregate areas of the open ocean so that individuals could not interact. Additionally, turtles are able to move around the surrounding open ocean waters to access more suitable habitats. The construction and operation are unlikely to fragment existing populations into two or more populations.
Adversely affect habitat critical to the survival of a species	Not likely There is no habitat critical to the survival for green turtles in the Project area, as these areas all occur on the east coast of Queensland (DCCEEW, 2024b). There is additionally no identified BIAs for this species in the Project area. While a small reduction of open sandy seabed habitat (<1.84 ha) will occur from installation of the pipeline, this habitat is not considered to be of high quality/importance for these species. Therefore, the Project will not have an adverse effect on habitat critical for survival of this species.
Disrupt the breeding cycle of an important population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of green turtles. There are no known breeding grounds in the vicinity of the Project area; however, breeding has been recorded on the eastern beaches of Groote Eylandt. The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean and access to inshore waters and beaches. Therefore, the Project is not likely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be destroyed from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Interfere substantially with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017a) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current Oil Spill Contingency Plan. Operation is unlikely to have direct or indirect impact on green turtles or their habitat, with mitigation measures in place. No impact will occur to the surrounding marine environment or any green turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. Green turtles do not demonstrate strong site fidelity to foraging grounds but do have site fidelity towards nesting beaches. There are no suitable nesting beaches in the Project area and there are no suitable foraging grounds to support large populations of this species. Therefore, there will be no impacts to this species. Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Flatback turtle

Biology and ecology

Flatback turtles are listed as vulnerable and migratory under the EPBC Act and not listed as threatened under the TPWC Act. Foraging of flatback turtles is mostly unknown with evidence supporting juveniles feeding on molluscs, squid and jellyfish, while adults may forage on cuttlefish and crinoids (DCCEEW, 2024b). Flatback turtles make long reproductive migrations similar to other species of marine turtles, although these movements are restricted to the continental shelf and there have been no studies of home ranges for this species (DCCEEW, 2024b).

Occurrence and habitat

There are no individuals recorded within Milner Bay with one record from 2014 in the channel between Groote Eylandt and Connexion Island (ALA, 2024). Most records of this species occur along the southern and eastern coasts of Groote Eylandt (NR Maps, 2024; DEPWS, 2024). Flatback turtle suitable habitat has been identified as soft bottom habitat over the continental shelf, with a pelagic life stage as hatchlings (DCCEEW, 2024b). While the Project area is dominated by soft bottom habitat, the area is not considered continental shelf.

Important populations

There are no important populations described for flatback turtles in the *Recovery Plan for Marine Turtles* (DEE, 2017b). Therefore, the local population is not considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Nesting and internesting habitat have been identified for each stock. For flatback turtles, this includes at least 70 per cent of nesting for the stock. The key nesting areas for flatback turtles in the NT are (DCCEEW, 2024b):

- Turtle Point area
- North Perron Island
- Bare Sand Island
- Tiwi Bioregion (in particular Brenton Bay to Tinganuwi Bay and west end Bathurst Island)
- Green Hill Island
- Cobourg Peninsula bioregion (in particular North Goulburn Island)

- Arnhem Wessel bioregion (in particular North West Crocodile Island, Small Island and north-east end Ingliss Island)
- Groote Bioregion (in particular Bremer Island, Bremer Islet and Isle Woodah)

Additional habitat critical to the survival for these species includes:

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Internesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The internesting habitat critical buffer for flatback turtles is 60 km.

Overall, there is no habitat critical to the survival in the Project area.

Nature and extent of impact

Potential impacts to flatback turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration: residual impact assessed as moderate
- Impacts and injury or mortality to individuals due to vessel strikes or interactions: residual impact assessed as minor
- Alteration of behaviours due to artificial lighting: residual impact assessed as minor
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm: residual impact assessed as minor

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Flatback turtles face a number of threats associated with the following broad categories of human activity:

- Commercial and recreational fishing
- Coastal infrastructure and development (including industrial, residential and tourism development)
- Indigenous harvest
- Feral animal predation of nests
- Climate change.

The pipeline corridor being installed for the Project would not be considered a threat to flatback turtles, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on flatback turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 24.. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated, the Project is considered not likely to have a significant impact on the vulnerable flatback turtle.

Table 24 Significant impact assessment – Flatback turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of an important population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter flatback turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of flatback turtle populations.
Reduce the area of occupancy of an important population	Not likely Flatback turtles only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing important population into two or more populations	Not likely There are no important populations of flatback turtles. This species is predominantly in deeper waters at the continental shelf and only migrating through the open ocean waters. There are no permanent populations in Milner Bay and no recent records of individuals to indicate they aggregate in the area. Species that do occur would currently co-exist around the existing port and activities. Only a small portion of habitat will be removed (<1.84 ha) for the pipeline, and this is located next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. The construction and operation are unlikely to fragment an important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Not likely Habitat critical to the survival of flatback turtles includes nesting beaches that occur on offshore islands of the NT including the Groote Eylandt archipelago, and the internesting buffer BIA that encompasses Groote Eylandt (DCCEEW, 2024b). However, the western beaches of the island are not known nesting beaches. While a small reduction of open sandy seabed habitat (<1.84 ha) will occur from installation of the pipeline, this habitat is not considered to be of high quality/importance for these species. Therefore, the Project will not have an adverse effect on habitat critical for survival of this species.
Disrupt the breeding cycle of an important population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of flatback turtles. There are no known breeding grounds in the vicinity of the Project area, with nesting in the archipelago identified as occurring on Bremer Island, Bremer Inlet and Isle Woodah (Chatto & Baker, 2008). The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean. The Project is unlikely to disrupt the breeding cycle of the species.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be impacted from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.
Interfere substantially with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current Oil Spill Contingency Plan. Operation is unlikely to have direct or indirect impact on flatback turtles or their habitat, with mitigation measures in place. No impact will occur to the surrounding marine environment or any flatback turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. There are no suitable nesting beaches in the Project area and there are no suitable foraging grounds to support large populations of this species. Therefore, there will be no impacts to this species. Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Hawksbill turtle

Biology and ecology

Hawksbill turtles are listed as vulnerable under the EPBC Act, and vulnerable under the TPWC Act. Hawksbill turtles forage on a variety of plants and animals including sponges, hydroids, cephalopods, jellyfish, seagrass and algae (DCCEEW, 2024b). Hawksbill turtles can migrate more than 2400 km between foraging and nesting areas but can also remain within a small area for several years (Limpus et al. 1992; Whiting 2000).

Occurrence and habitat

There are records of individuals recently (i.e. within the past 10 years) recorded within Milner Bay (ALA, 2024; DEPWS, 2024); however, most records occur on the eastern side of Groote Eylandt and on the mainland waters north of Numbulwar. The majority of records are from the southern and eastern beaches of Groote Eylandt. Hawksbill turtle suitable habitat has been identified as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds (DCCEEW, 2024b). In the Project area there is only sparse inshore coral reef habitat, comprising individual coral colonies rather than established reef areas, but there is suitable nesting habitat around Groote Eylandt.

Important populations

There are no important populations described for hawksbill turtles in the *Recovery Plan for Marine Turtles* (DEE, 2017a). Therefore, the local population is not considered an important population.

Habitat critical to the survival

Habitat critical to the survival of a species for marine turtle stocks has been identified by consensus of a panel of experts in marine turtle biology. Nesting and internesting habitat have been identified for each stock. For hawksbill turtles, this includes at least 70 per cent of nesting for the stock. The key nesting areas for hawksbill turtles in the NT are:

- Truant and Bromby Island
- The Groote Eylandt archipelago (DEE, 2017a).

Additional habitat critical to the survival for the species includes (DEE, 2017a):

- Where relevant, nesting habitat determined to be critical to the survival of marine turtles includes areas that are: geographically dispersed; major and minor rookeries; mainland and island beaches; and winter or summer nesting.
- Nesting habitat critical to the survival of marine turtles is located immediately seaward of designated nesting habitat critical to the survival of marine turtles. The habitat critical buffer for hawksbill is 20 km.

While Groote Eylandt archipelago is one of the densest areas of hawksbill turtle nesting, the nesting occurs predominantly on the smaller islands such as North East, Hawk and Lane Island group located 30 km north-east of Groote Eylandt (Hoenner *et al.*, 2016). Key rookeries, where more than 500 nesting females occur yearly are Long, Hawkesbury and Dayman Island in Torres Strait and Rosemary Island in the Dampier archipelago in Western Australia (Limpus *et al.*, 2000; Limpus 2009). While there are rookeries within the Groote Eylandt archipelago, there are no large rookeries within the Project area, nor is the Project area adjacent to known nesting habitat. There is no habitat critical to the survival in the Project area that would be impacted by the Project.

Nature and extent of impact

Potential impacts to hawksbill turtle as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

In Australia, the main current threats to hawksbill turtles are:

- Disturbance and habitat damage due to coastal development
- By-catch from fisheries and shark control
- Predation on nests
- Boat strikes
- Entanglement and ingestion of marine debris
- Unsustainable levels of Indigenous harvest, in some areas.

The pipeline corridor being disturbed for the Project would not be considered a threat to hawksbill turtles, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

To determine if the Project is likely to have a significant impact on hawksbill turtles, a significant impact assessment against the Commonwealth's *Significant Impact Guideline 1.1* (DoE, 2013) has been undertaken in Table 25. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on the vulnerable hawksbill turtle is not considered likely to occur.

Table 25 Significant impact assessment – Hawksbill turtles

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of an important population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory habitat for this species, while no foraging or breeding habitat was identified. The potential noise and vibration during installation of the marine infrastructure is likely to deter any turtles from the vicinity of the Project area, reducing the potential for direct harm to individuals from vessel interactions. While noise may deter hawksbill turtles from migrating through the area, this impact will be localised and temporary. As noted, this would not deter individuals from accessing any key foraging habitats. During construction, mitigation measures will be implemented to ensure aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in temporary loss of <1.84 ha of open sandy seabed. However, with the very large range of these species, this is not considered a significant loss of migration habitat. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. Overall, the marine infrastructure is minimal in size, adjoining existing infrastructure, and would not disrupt the migration patterns of marine turtles moving through the area. The marine infrastructure will not impede on turtle movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of hawksbill turtle populations.
Reduce the area of occupancy of an important population	Not likely Hawksbill turtles only migrate through the Project area and are not considered permanent residents. There is also no foraging or nesting habitat around the Project area that the turtles would occupy for long periods of time. Corals on rocky reefs are also present adjacent to the Project area but are in low density and would not be considered a significant resource. Only a small portion of open sandy seabed will be temporarily removed (<1.84 ha), and this is located in shore next to existing infrastructure and would not impede on turtle movement or occupancy to other suitable habitats. Therefore, the Project will not reduce the area of occupancy of this species.
Fragment an existing important population into two or more populations	Not likely There are no important populations of hawksbill turtles on Groote Eylandt. This species is predominantly pelagic and migratory occurring along the entire coast of Australia and in the open ocean. There are no permanent populations in Milner Bay and no recent records of individuals to indicate they aggregate in the area. Hawksbill turtles that do occur would currently co-exist around the existing port and activities. Additionally, turtles are able to move around the surrounding open ocean waters to access more suitable habitats. The construction and operation are unlikely to fragment an important population into two or more populations.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Adversely affect habitat critical to the survival of a species	Not likely Habitat critical to the survival of hawksbill turtles occurs on offshore islands of the NT including the Groote Eylandt archipelago (DCCEEW, 2024b). However, this habitat occurs on the eastern side of the island. The Project area is not considered habitat critical to the survival of the species and the Project will not affect habitat on the eastern side of the island due to construction or operation. While a small reduction of open sandy seabed habitat (<1.84 ha) will occur from installation of the pipeline, this habitat is not considered to be of high quality/importance for these species
Disrupt the breeding cycle of an important population	Not likely Breeding grounds and migration pathways to and from the breeding grounds are key components of the breeding cycle of hawksbill turtles. There are no known breeding grounds in the vicinity of the Project area; however, there are breeding grounds throughout the archipelago. The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean. The Project is not likely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of bare sand substrate will be destroyed from installation of the pipeline. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Introduce disease that may cause the species to decline	Not likely A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by poor water quality and bacterial infections can result from injuries caused by boat strikes (DEE, 2017a). However, to date, there are no recorded occurrences of diseases and pathogens affecting the viability of a marine turtle stock in Australia (DEE, 2017a). Therefore, there are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. It is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the turtle populations will decline.
Interfere substantially with the recovery of the species	Not likely The current <i>Marine Turtle Recovery Plan</i> (DEE, 2017a) outlines the recovery strategies for the species. Relevant to the Project, the recovery strategy aims at minimising chemical and terrestrial discharge with the implementation of best management of industrial, urban and agriculture runoff. Spill risk and spill response strategies are to be implemented including adherence to GEMCO's current Oil Spill Contingency Plan. Operation is unlikely to have direct or indirect impact on hawksbill turtles or their habitat, with mitigation measures in place. No impact will occur to the surrounding marine environment or any hawksbill turtle nesting habitat. The Recovery Plan also emphasises the need to ensure that marine turtles are not displaced as a result of infrastructure and development. Hawksbill turtles do not demonstrate strong site fidelity to foraging grounds but do have site fidelity towards nesting beaches. There are no suitable nesting beaches in the Project area and there are no suitable foraging grounds to support large populations of this species in Milner Bay. Therefore, there will be no impacts to this species. Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions.

Green sawfish

Biology and ecology

The green sawfish is listed as vulnerable and migratory under the EPBC Act, and vulnerable under the TPWC Act. Green sawfish have a shark-like body, a flattened head and an elongated snout or rostrum, which is studded with 24–28 pairs of unevenly-spaced rostral teeth. They are a long-lived species that produces few pups and matures late in life (Stevens *et al.* 2005; Walker 1998) and generation length has been estimated to be about 16 years (Stevens *et al.* 2005). Green sawfish forage on a variety of prey including shoaling fish such as mullet, which are stunned by sideswipes of the snout, molluscs and small crustaceans swept out of the sand and mud by the saw and active pursuit of schools of baitfish and prawns (DCCEEW, 2024b).

Occurrence and habitat

Green sawfish have not been confirmed present within the Project area and only a few older records (>10 years) occur in the waters off the southwest of Groote Eylandt (ALA, 2024; DEPWS, 2024).

Green sawfish are known to inhabit muddy bottom habitats and estuaries but also have been recorded from inshore marine waters and along sandy and muddy beaches (DCCEEW, 2024b). Smaller specimens (<2.5 m in length) are more common in foreshore and offshore coastal waters, as well as estuaries and river mouths at slightly reduced salinities, but do not venture into freshwater (Thorburn *et al.*, 2004). Larger individuals (>2.5 m in length) are found in both inshore and offshore waters. Their apparent preference for shallow inshore waters as nursery areas increases the likelihood of interaction with inshore gillnets (Stevens *et al.*, 2005). There was suitable general habitat recorded in the Project area in the form of shallow inshore waters along sandy beaches.

Important populations

There are no known important populations for this species listed in the Conservation Advice (DEWHA, 2008).

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b).

Nature and extent of impact

Potential impacts to green sawfish as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Direct mortality from piling or crushing from anchor chains
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Green sawfish face a number of threats associated with the following broad categories:

- Commercial and recreational fishing
- Shark finning
- Habitat degradation
- Indigenous harvesting
- Reproduction constraints

The pipeline corridor being installed for the Project would not be considered a threat to green sawfish, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

The Project occurs within known migratory and potential foraging habitat for green sawfish. Green sawfish have not historically used the area during standard operations nor has there been any reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls. To determine if the Project is likely to have a significant impact on green sawfish, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 26. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on green sawfish is not considered likely to occur.

Table 26 *Significant impact assessment – Green sawfish*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Lead to a long-term decrease in the size of an important population	Not likely The Project area is located over primarily open sandy seabed habitat that acts as migratory for this species, while not foraging or breeding habitat was identified in the Project area. The potential noise and vibration during installation of the marine infrastructure is likely to deter any sawfish from the vicinity of the Project area, reducing the potential for direct harm to individuals. This impact will be localised and temporary. During construction, mitigation measures will be implemented so that aquatic fauna are given the opportunity to disperse from the area before works commence each day. It is expected that construction of the new infrastructure will result in a permanent loss of bare sandy substrate and open water space. However, with the very large range of these species, this is not considered a significant loss of migration habitat. As these species are benthic, and the waters of the construction area are typically too turbid to see the bottom substrate, monitoring for this species prior to works cannot be undertaken. However, green sawfish are unlikely to occur in the area due to existing disturbance in the wharf area (i.e. barges and large port vehicles). Due to the depth of the water, vessel strike is not a potential impact for sawfish. The proposed marine infrastructure is minimal in size (<1.84 ha), adjoining existing infrastructure, and would not disrupt the migration patterns of green sawfish moving through the area. The marine infrastructure will not impede on sawfish movement along the coast and therefore not disrupt their life cycles so that there is a long-term decrease in the size of either population.
Reduce the area of occupancy of an important population	Not likely There are no known important populations of this species. Green sawfish may migrate and forage in the Project area; however, they would not be considered permanent residents. The area is not a known aggregation spot for this species and there are limited historical records around Groote Eylandt to indicate that individuals would frequent the area. Only a small portion of habitat will be temporarily removed (<1.84 ha) for the piles, and these are located in shore next to existing infrastructure and would not impede on sawfish movement or occupancy to other suitable habitats. The Project is not anticipated to reduce the area of occupancy of this species due to the small footprint and short construction period. Vessel traffic will continue to occur in the port and the addition of vessels used for this Project will unlikely impact on green sawfish use of Milner Bay.
Fragment an existing important population into two or more populations	Not likely There are no important populations of green sawfish. This species is predominantly benthic and migratory occurring throughout the Gulf of Carpentaria and is known to occur in shallow waters. However, there are no permanent populations in Milner Bay and no recent records of individuals to indicate they aggregate in the area. Additionally, sawfish are able to move around the surrounding benthic habitats to access more suitable habitats. Therefore, the construction and operation will not fragment an important population into two or more populations.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Adversely affect habitat critical to the survival of a species	Not likely Habitat critical to the survival of green sawfish has not been defined. However, this species is known to inhabit muddy bottom habitats and estuaries but also has been recorded from inshore marine waters and along sandy and muddy beaches, which are present in the Project area. The Project area is small (<1.84 ha) and construction is temporary. Although muddy bottom habitats will be removed or affected, these habitats in Milner Bay are widely represented in the region and are unlikely to be considered critical to the survival of this species.
Disrupt the breeding cycle of an important population	Not likely Sawfish return seasonally to inshore coastal waters adjacent to the northern Australian region to breed and pup (DCCEEW, 2024b). There are no known breeding grounds for this species and there are unlikely any significant breeding areas in the vicinity of the Project area or around Groote Eylandt. The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean and surrounding waters. Green sawfish reproduce via aplacental viviparity (i.e. embryos develop inside eggs that are retained within the mother's body until they are ready to hatch). Therefore, green sawfish breeding would only be disrupted by interference with the fertilisation process or by direct mortality to females. Both potential impacts are unlikely as there are unlikely to be breeding aggregations of this species around Groote Eylandt. However, this species is rare and understudied. Nonetheless, the Project is considered unlikely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of open sandy seabed will be destroyed from the piling activities. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Introduce disease that may cause the species to decline	Not likely There are no known diseases that these species are susceptible to or threatened by that proposed works have the potential to introduce. Therefore, it is considered unlikely that construction works and operation will have the potential to introduce disease to the extent that the sawfish populations will decline.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Assessment
Interfere substantially with the recovery of the species	Not likely There is currently no recovery plan for this species. One of the main threats to this species is by-catch from commercial fisheries, which is not a component of this Project. The Approved Conservation Advice for green sawfish (TSSC 2008) recommends the following priority actions: – Identify known sites of high conservation priority. – Protect remnants of the listed species through the development of conservation agreements and covenants with the fishing community. – Raise awareness of the species within the local, Indigenous and fishing communities, including species identification and handling techniques for bycatch specimens. – Improve reporting of interactions with commercial, recreational and Indigenous fishers. – Undertake research into the biology, ecology and threats to the species. – Work with fishers to develop appropriate codes of conduct for handling specimens to reduce incidental mortality. – Develop bycatch mitigation measures and gear technologies to reduce threats. – Assess the efficacy of current incidental threat abatement measures. – Mitigate Illegal Unreported Unregulated (IUU) fishing pressure on the species. – Mitigation measures will ensure that the Project is unlikely to contribute to key threatening processes or interfere with recovery actions. Based on the minimal records of this species around Groote Eylandt, the Project is unlikely to interfere with the recovery of this species.

Narrow sawfish

Biology and ecology

The narrow sawfish is listed as migratory under the EPBC Act and is not listed as threatened under the TPWC Act. Narrow sawfish have a shark-like body, a flattened head and an elongated snout or rostrum, which is studded with pairs of unevenly spaced rostral teeth and is different to green sawfish by having no rostral teeth on the basal quarter of the rostrum (Kyne & Pillans 2014). The narrow sawfish feeds on small fish, squid, and invertebrates such as crabs and shrimp (ALA, 2024).

Occurrence and habitat

Narrow sawfish have not been confirmed present within the Project area and only a few older records (>20 years) occur in the waters off the southwest of Groote Eylandt (ALA, 2024; DEPWS, 2024).

Narrow sawfish are known from shallow coastal waters and estuaries of the Indo-West Pacific, ranging from the Persian Gulf to southern Japan, Papua New Guinea and northern Australia. The narrow sawfish is benthic-pelagic and is found at depths of about 100 meters. The narrow sawfish prefers soft bottom-substrates, such as sand, mud, or seagrass, to rocky or coralline habitats. It can tolerate low salinity levels and is found in inshore waters, including bays and estuaries (ALA, 2024). There was suitable general habitat recorded in the Project area for this species in the form of sand and mud substrates; however, the depth of water in the Project area is shallower than where these species normally occur.

Important populations

There are no known important populations for this species and there is no approved Conservation Advice (DCCEEW, 2024b).

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b).

Nature and extent of impact

Potential impacts to narrow sawfish as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Direct mortality from piling or crushing from anchor chains
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

There are no key threats identified for this species as well as no approved Conservation Advice, Listing Advice or Recovery Plan (DCCEEW, 2024b).

Significant impact assessment

The Project occurs within potential migratory and foraging habitat for narrow sawfish. Narrow sawfish have not historically used the area during standard operations nor has there been any reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls. To determine if the Project is likely to have a significant impact on narrow sawfish, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 27. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on narrow sawfish is not considered likely to occur.

Table 27 *Significant impact assessment – Narrow sawfish*

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Not likely The works will be restricted spatially to small, localised areas. Only a small area (<1.84 ha) of open sandy seabed will be destroyed from the piling activities. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	Not likely Sawfish return seasonally to inshore coastal waters adjacent to the northern Australian region to breed and pup (DCCEEW, 2024b). There are no known breeding grounds for this species and there are unlikely any significant breeding areas in the vicinity of the Project area or around Groote Eylandt. The new infrastructure will be a minimal barrier to movement and still allow fauna passage throughout the open ocean and surrounding waters. Narrow sawfish reproduce via aplacental viviparity (i.e. embryos develop inside eggs that are retained within the mother's body until they are ready to hatch). Therefore, narrow sawfish breeding would only be disrupted by interference with the fertilisation process or by direct mortality to females. Both potential impacts are unlikely as there are unlikely to be breeding aggregations of this species around Groote Eylandt. However, this species is rare and understudied. Nonetheless, the Project is considered unlikely to disrupt the breeding cycle of the species.

Estuarine crocodile

Biology and ecology

The estuarine crocodile is listed as migratory under the EPBC Act and not listed as threatened under the TPWC Act. The species is documented to occur in Australian coastal waters from Rockhampton in Queensland through coastal NT waters to King Sound in Western Australia (DCCEEW, 2024b). The species has also been upstream in freshwater environments of larger rivers and creeks.

Estuarine crocodiles nest during the wet season, between November and May, with a peak between January and February (DCCEEW, 2024b). Large males control a territory through aggression and signalling, and consequently fertilise most reproductively active females within it. This species predominantly forages on crustaceans, insects and mammals but may also consume marine turtles, fish and birds (Webb and Manolis, 1989).

Occurrence and habitat

Estuarine crocodiles have been confirmed present within the Study area; however, typically just migrating through the open water and not resting on nearby beaches.

General habitat for estuarine crocodiles is in tidal rivers, coastal floodplains and channels, billabongs and swamps, while nesting habitat is in isolated freshwater swamps that do not experience tidal movement (Webb *et al.*, 1987). There was no suitable general habitat recorded in the Project area.

Important populations

There are no known populations for Groote Eylandt and no important populations have been identified. Average sightings per kilometre from NT rivers is 4.01 and overall population in the NT was last reported as between 70,000 and 75,000 (DCCEEW, 2024b). Individuals have been recorded in estuarine creeks around Groote Eylandt, with the closest being Angurugu Creek located over 10 km south of the Project area.

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b).

Nature and extent of impact

Potential impacts to estuarine crocodiles as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Key threats to estuarine crocodile are listed as mortality due to fishing nets and habitat destruction, including destruction by feral animals such as buffalo (DCCEEW, 2024b).

The pipeline corridor being installed for the Project would not be considered a threat to narrow sawfish, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

The Project occurs within known migratory and potential foraging habitat for estuarine crocodiles but avoids direct impacts to their breeding and resting habitat. Estuarine crocodiles have historically used the area during standard operations and there have been no reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls.

To determine if the Project is likely to have a significant impact on estuarine crocodiles, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 28. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on estuarine crocodiles is not considered likely to occur.

Table 28 *Significant impact assessment – Estuarine crocodile*

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Not likely There is no important habitat described for this species and there is no approved Conservation Advice under the EPBC Act (DCCEW 2024). General habitat for estuarine crocodiles is in tidal rivers, coastal floodplains and channels, billabongs and swamps, while nesting habitat is in isolated freshwater swamps that do not experience tidal movement (Webb et al. 1987). The Project area comprises open ocean waters and developed port areas, which would only constitute temporary migratory habitat. Indirect impacts have the potential to cause disturbance due to alteration of fauna movement from construction activities and associated noise and vibration, as well as reducing water quality in the form of sediment plumes during piling. Impacts will be managed through avoidance (i.e. construction halted when an individual is spotted within shutdown zones) and standard practice mitigation controls including implementation of Construction Environmental Management Plan. Operational impacts from the Project are not expected to impact this species or habitat, as evidence by their occurrence during regular operations of the Port. As such, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for estuarine crocodiles.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Not likely There are no known aggregations of estuarine crocodiles in the area or on Groote Eylandt. Occurrences of this species listed on the Atlas of Living Australia and NR Maps are limited to a few individuals. Direct impacts to the species and its main habitat will be avoided. Indirect impacts will be controlled via detailed management plans and are not expected to interfere with the mobility of this species throughout the Project area.

Dugong

Biology and ecology

Dugongs are listed as migratory under the EPBC Act and not listed as threatened under the TPWC Act. The species occur in coastal and island waters from Shark Bay in Western Australia across the northern coastline to Moreton Bay in Queensland. The dugong is a large herbivorous marine mammal with paddle-like forelimbs and no hind limbs or dorsal fin, which comes to the surface to breathe. This species forages predominantly on seagrass but may also consume macroinvertebrates and algae as they excavate seagrass from the sediment.

Occurrence and habitat

Dugongs have been confirmed present within the Study area; however, typically just migrating through the open water and inshore areas.

Dugongs spend most of their time in the neritic zone, especially near tidal and subtidal seagrass meadows (DCCEEW, 2024b). Specific areas supporting dugongs in the NT include the northern coast (i.e. the Daly River to Millingimbi, including Melville Island and Vernon Islands and the Darwin region); and the Gulf of Carpentaria, including the waters between Blue Mud Bay and Groote Eylandt (Marsh *et al.*, 2008; Grech *et al.*, 2011). Within the Gulf of Carpentaria, the Sir Edward Pellew and Wellesley Islands are the most important dugong habitats ((Marsh *et al.*, 2008; Grech *et al.*, 2011).

There was no suitable foraging habitat recorded in the Project area as there was a lack of dense seagrass meadows. There was suitable migratory habitat throughout the Project area.

Important populations

There are no described important populations for dugongs; however, within the Gulf of Carpentaria, the Sir Edward Pellew and Wellesley Islands are the most important dugong habitats. No important populations have been identified around Groote Eylandt.

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b) but assumed to be areas of dense seagrass meadows in tropical and sub-tropical waters.

Nature and extent of impact

Potential impacts to dugongs as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

The *Action Plan for Australian Mammals 2012* (Woinarski *et al.*, 2014) identified the following threats to dugongs in Australian waters:

- Habitat degradation
- Pollution
- Entanglement and incidental by-catch in fishing gear
- Indigenous hunting
- Vessel strike
- Anthropogenic noise and acoustic disturbance
- Climate change

The pipeline corridor being installed for the Project would not be considered a threat to dugongs, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

The Project occurs within known migratory habitat for dugongs, but the area is not considered significant foraging habitat. Dugongs have historically used the area during standard operations and there have been no reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls.

To determine if the Project is likely to have a significant impact on dugongs, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 29. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on dugongs is not considered likely to occur.

Table 29 Significant impact assessment – Dugong

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Not likely There is no important habitat described for this species and there is no approved Conservation Advice under the EPBC Act (DCCEEW, 2024). However, it is assumed that dense seagrass meadows are required to support populations of this species, as this is their main food source. No dense seagrass meadows have been identified through desktop searches or recent habitat mapping and therefore no important habitat occurs in the Project area. The Project area comprises soft-bottom sand and mud habitat with historic occurrences of sparse seagrass; however, this seagrass would not support the amount of seagrass an individual would consume on a daily basis (i.e. 30 kg) (Department of Environment, Science and Innovation (DESI), 2024) Indirect impacts have the potential to cause disturbance due to alteration of fauna movement from construction activities and associated noise and vibration, as well as reducing water quality in the form of sediment plumes during piling. Impacts will be managed through avoidance (i.e. construction halted when an individual is spotted within shutdown zones) and standard practice mitigation controls including implementation of a Construction Environmental Management Plan. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. As such, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for dugongs.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Not likely There are no known aggregations of dugongs in the Project area, with known aggregations to north between Groote Eylandt and Blue Mud Bay (Grech <i>et al.</i>, 2011). Occurrences of this species listed on the Atlas of Living Australia and NR Maps are limited to a few individuals in the Study area and these are likely transient individuals migrating to seagrass meadows in the wider region. Direct impacts to the species and its main habitat will be avoided or mitigated. Indirect impacts will be controlled via detailed management plans and are not expected to interfere with the mobility of this species throughout the Project area.

Australian snubfin dolphin

Biology and ecology

Australian snubfin dolphins are listed as migratory under the EPBC Act and are currently under a threatened listing assessment by DCCEEW (due for completion by 30/10/24) and are not listed as threatened under the TPWC Act. This species occurs in coastal and island waters from Shark Bay in Western Australia across the northern coastline to Moreton Bay in Queensland. The Australian snubfin dolphin has a broadly rounded head with a straight mouthline, and no signs of a beak. The dorsal fin is small and situated on the back half of the body, and the broad paddle-like flippers make it extremely mobile. This species comes to the surface to breathe; however, unlike most dolphins, the Australian snubfin dolphin has a u-shaped blowhole that opens to the front.

Occurrence and habitat

Australian snubfin dolphins have been confirmed present within the Project area; however, this is likely transient movement through the open water to inshore areas.

In Australia, the Australian snubfin dolphins have almost exclusively been recorded in coastal and estuarine environments in waters less than 20 m deep. This species prefers protected coastal waters close to river and creeks mouths, and seagrass beds where they can forage for food; primarily small-bodied fish (DCCEEW, 2024b). There was no suitable foraging habitat recorded in the Project area as there was a lack of dense seagrass meadows, and river and creek mouths are located elsewhere, such as Angurugu Creek. There is suitable migratory habitat throughout the Project area.

Important populations

There are no described important populations for the Australian snubfin dolphin. They live in small, isolated groups with generally less than 100 individuals. No important populations have been identified around Groote Eylandt.

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b) but assumed to be coastal and estuarine areas located in proximity to rivers and creek mouths.

Nature and extent of impact

Potential impacts to Australian snubfin dolphins as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Key threats to Australian snubfin dolphins have been identified as:

- Habitat destruction and degradation
- Incidental capture in gillnets
- Traditional hunting by Indigenous Australian communities
- Live capture for oceanariums

The pipeline corridor being installed for the Project would not be considered a threat to dugongs, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

The Project occurs within known migratory habitat for the Australian snubfin dolphin but is not considered to be significant foraging habitat. These dolphins have historically been observed in the area during standard operations and there have been no reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls.

To determine if the Project is likely to have a significant impact on Australian snubfin dolphins, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 30. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on Australian snubfin dolphins is not considered likely to occur.

Table 30

Significant impact assessment – Australian snubfin dolphin

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Not likely There is no important habitat described for this species and there is no approved Conservation Advice under the EPBC Act (DCCEW 2024). However, it is assumed that coastal and estuarine inshore areas near river and creeks are required to support populations of this species, as these characterise their general habitat. The Project area comprises open ocean waters and developed port areas, which would only constitute temporary migratory habitat. River and creek mouths are located outside the Project area. Therefore, no important habitat is considered to occur in the Project area. Indirect impacts have the potential to cause disturbance due to alteration of fauna movement from construction activities and associated noise and vibration, as well as reducing water quality in the form of sediment plumes during piling. Impacts will be managed through avoidance (i.e. construction halted when an individual is spotted within shutdown zones) and standard practice mitigation controls including implementation of a Construction Environmental Management Plan. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. As such, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for Australian snubfin dolphins.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Not likely There are no known aggregations of Australian snubfin dolphins in the Project area or around Groote Eylandt. Occurrences of this species listed on the Atlas of Living Australia and NR Maps are limited to a few individuals in the Project area and these are likely transient individuals migrating to estuarine and coastal habitats in the wider region. Direct impacts to the species and its main habitat will be avoided or mitigated. Indirect impacts will be controlled via detailed management plans and are not expected to interfere with the mobility of this species throughout the Project area.

Australian humpback dolphin

Biology and ecology

Australian humpback dolphins are listed as migratory under the EPBC Act and are currently under a threatened listing assessment by DCCEW (due for completion by 30/10/24) and are not listed as threatened under the TPWC Act. This species occurs in coastal and island waters from Shark Bay in Western Australia across to the Queensland-New South Wales border. The Australian humpback dolphin can be differentiated by other *Sousa* species by its darker colouration, triangular dorsal fin which is lower and wider at the base, and white scarring and dark flecks on adults (DCCEW, 2024b).

Occurrence and habitat

Australian humpback dolphins have been confirmed present within the Project area; however, this is likely transient movement through the open water to coastal inshore regions.

In Australia, the Australian humpback dolphins are typically found in shallow coastal waters less than 15-20 m deep, mainly within 10 km of the coast, and within 20 km of the nearest river mouth based on observations in the NT and Queensland (Parra and Cagnazzi 2016). This species utilises a wide range of near-shore habitats, and there appears to be a high adaptability of this species to local environment characteristics (Parra and Cagnazzi 2016). Due to the generalist and opportunistic feeding preferences of this species, it is considered that there is suitable migratory and foraging habitat throughout the Project area.

Important populations

There are no described important populations for the Australian humpback dolphin. There is currently no range-wide information available for the populations of this species. Available estimates of a few populations suggest that these dolphins occur in small populations averaging 54-89 individuals (Parra and Cagnazzi, 2016). No important populations have been identified around Groote Eylandt.

Habitat critical to survival

Habitat critical to survival of the species is not defined (DCCEEW, 2024b) but assumed to be coastal and estuarine areas located in proximity to rivers and creek mouths.

Nature and extent of impact

Potential impacts to Australian humpback dolphins as a result of the proposed works for the Project, include the following:

- Disturbance to migratory pathways from noise and vibration
- Impacts and injury or mortality to individuals due to vessel strikes or interactions
- Degradation of water quality that could impact on foraging or other behaviours, or in extreme cases causes physiological harm

The extent of impact is restricted to the Project area as defined in Table 2.

Key threats

Key threats to Australian snubfin dolphins have been identified as:

- Habitat loss and degradation
- By-catch
- Water pollution
- Underwater noise
- Floods
- Vessel traffic
- Overfishing of prey resources
- Wildlife tourism

The pipeline corridor being installed for the Project would not be considered a threat to dugongs, as it covers a small area (<1.84 ha) located adjacent to the existing wharf. This area does not constitute quality habitat, primarily consisting of open sandy seabed outside of the continental shelf. No other key threats are relevant to the proposed Project.

Overall, the Project will not have an influence on any of the key threats to this species.

Significant impact assessment

The Project occurs within known migratory and potential foraging habitat for the Australian humpback dolphin. These dolphins have historically been observed in the area during standard operations and there have been no reported impacts to this species. All potential impacts will be managed through avoidance and mitigation controls.

To determine if the Project is likely to have a significant impact on Australian humpback dolphins, a significant impact assessment in accordance with the Commonwealth's *Significant Impact Guidelines 1.1* has been undertaken in Table 31. The significant impact assessment is based on the extent of impact to the species within the Project area.

Due to the lack of significant residual impacts associated with the Project, a significant impact on Australian humpback dolphins is not considered likely to occur.

Table 31 *Significant impact assessment – Australian humpback dolphin*

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Not likely There is no important habitat described for this species and there is no approved Conservation Advice under the EPBC Act (DCCEW 2024). However, it is assumed that coastal and estuarine inshore areas near river and creeks are required to support populations of this species, as these characterise their general habitat. The Project area comprises open ocean waters and developed port areas, which would only constitute temporary migratory habitat. River and creek mouths are located outside the Project area. It is considered therefore that no important habitat occurs in the Project area. Indirect impacts have the potential to cause disturbance due to alteration of fauna movement from construction activities and associated noise and vibration, as well as reducing water quality in the form of sediment plumes during piling. Impacts will be managed through avoidance (i.e. construction halted when an individual is spotted within the shutdown zone) and standard practice mitigation controls including implementation of a Construction Environmental Management Plan. During construction and operation, vessels will be operating under speed limits no greater than 5 knots. These speeds are considered suitable for minimising the potential for direct impact to marine fauna and reducing the potential for mortality. As such, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for Australian humpback dolphins.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Not likely The potential introduction of invasive marine species (IMS) during the Project will be managed via adherence to Australian quarantine requirements and Port biosecurity management plans. As the Project area does not constitute quality habitat, the species are also expected to occur in the Project as transient visitors only which further reduces the risk of IMS transmission to the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Not likely There are no known aggregations of Australian humpback dolphins in the Project area or around Groote Eylandt in general. Occurrences of this species listed on the Atlas of Living Australia and NR Maps are limited to a few individuals in the Project area and these are likely transient individuals migrating to estuarine and coastal habitats in the wider region. Direct impacts to the species and its main habitat will be avoided or mitigated. Indirect impacts will be controlled via detailed management plans and are not expected to interfere with the mobility of this species throughout the Project area.

Appendix D

**WSP Marine Survey Report – September
2023**

**Design
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South32 GEMCO

**WP05: Environmental
Baseline Assessment and
Studies – Phase 2**

Marine Habitat Mapping

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October 2023

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WP05: Environmental Baseline Assessment and Studies – Phase 2 Marine Habitat Mapping

South32 GEMCO

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DRAFT

1 Introduction

1.1 Purpose

South32 have engaged WSP to undertake a marine survey to describe the composition and spatial distribution of seabed habitats in the vicinity of the port and proposed pipeline alignment. This report has been prepared for South32 by WSP Pty Ltd to map and describe the marine habitats in the vicinity of a proposed ocean outfall that would service their GEMCO operations on Groote Eylandt in the Northern Territory.

This report is intended to support decision-making for the port ocean outfall design and, specifically, the alignment of the seabed pipeline to the immediate south of the Milner Bay Port. The marine habitat maps will also provide the basis of subsequent baseline marine ecological studies related to the development of the GEMCO ocean outfall.

The purpose of the marine habitat mapping is to provide an understanding of the marine receiving environment, the benthic (seabed) conditions and ecological receptors (i.e., marine species or communities) including:

- Ecologically significant and sensitive habitats in the immediate vicinity of the proposed pipeline alignment and within the potential discharge mixing zones.
 - Specific marine fauna and flora that are sensitive or vulnerable to the impacts of the discharged water based on dispersion modelling and predicted concentrations of key components.
 - Resources that are culturally significant to Traditional Owners.
 - This information will be used to inform the placement of the pipeline to the south of the port.
-

1.2 Report Scope

The scope of the marine habitat mapping report is to:

- Collect a visual record of the benthic habitats in the predicted extent of the marine receiving environment, using a Remotely Operated Vehicle (ROV) to obtain video footage.
- Describe the habitat types and their spatial extent within the receiving environment.
- Create a map showing the distribution of habitats within the receiving environment.
- Engage with Traditional Owners to gain an understanding of the cultural significance and common use of the Groote Eylandt marine environment and its resources.
- Provide a broadscale understanding of the marine benthic habitats in the vicinity of the proposed discharge and the potential sensitivity of these habitats to the proposed works and ongoing discharge.

2 Project Description

2.1 Background

South32's GEMCO operation is one of the top 10 wettest metal mines in the world, based on current groundwater inflow estimates. Mining at the Western Leases creates large volumes of water during its operation. The existing process (bush discharge) for disposal of process water is not sustainable due to the risk of increased salinity of the excess water from quarries. Consequently, GEMCO has undertaken an analysis of western lease water disposal options.

In 2022, WSP delivered a Water Disposal Options Analysis ('Options report') that assessed several options for water disposal, including on-lease discharge to bush or watercourses, large water storage, aquifer recharge, and an ocean outfall. The Options report considered three locations for an ocean outfall along the western coastline – the port at Milner Bay, J -Quarry, and the Western Lease. The likely construction methods, environmental impacts, site suitability, site accessibility, approval pathways and costs were assessed for each location.

Milner Bay Port was selected as the preferred location for an ocean outfall with a lay-on-bed pipeline structure. This location was chosen based on information obtained from existing documents and reports that described the water mixing characteristics and highly modified nature of the site. This existing data and information are documented in the GEMCO Water Disposal PFS Environmental Baseline Studies Desktop Assessment Report.

Environmental assessments are required to support the development of the ocean outfall at Milner Bay, including marine ecological studies, water quality assessments, dispersal modelling, and geotechnical surveys.

This report has been prepared as the first step for marine ecological studies, providing an overview of the marine habitats in the vicinity of the GEMCO port, covering the potential pipeline layout and modelled dispersal/mixing zones. This information will be used as the basis for the baseline marine ecological assessment. That assessment will be a desktop report to support project referrals under the Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act) and the Northern Territory Environment Protection Act 2019 (EP Act).

2.2 Location

The GEMCO manganese mining operations include the port facilities at Milner Bay where shipping operations for the mine are undertaken using a conveyor system and shiploader. Given the highly modified marine habitat in this area, GEMCO have determined this area as the most suitable for a proposed ocean outfall. The study and Milner Bay Port are shown in Figure 2-1.



Figure 2-1 Aerial image showing the layout of the port and boundary of the marine habitat mapping survey undertaken in September 2023.

3 Methods

3.1 Field Survey

A marine ecological survey was undertaken in the vicinity of Milner Bay Port on the west coast of Groote Eylandt on 28 to 30 September 2023.

The survey area included the predicted extent of the pipeline alignment and the most recent discharge dispersion model prepared by GHD (GHD Marine Discharge Modelling report).

A three-dimensional (3D) far-field hydrodynamic model was developed by GHD, calibrated, and validated for the southwestern region of the Gulf of Carpentaria with refined resolution in the vicinity of Groote Eylandt and the proposed marine outfall site. The discharge scenario 3 for 80 GL/a (was simulated and the following far-field simulations yielded the following predictions:

- The outer extent of the surface mixing zone for potential indirect effects (42-fold dilution target related to nitrate stimulation) is predicted to be: ~550 m north-northwest and ~450 m southeast from the diffuser for Scenario 3 (80 GL/a)
- The outer extent of the surface mixing zone for potential direct effects (35-fold dilution target related to salinity reduction) is predicted to be ~300 m north-northwest and ~300 m southeast from the diffuser for Scenario 3 (80 GL/a)

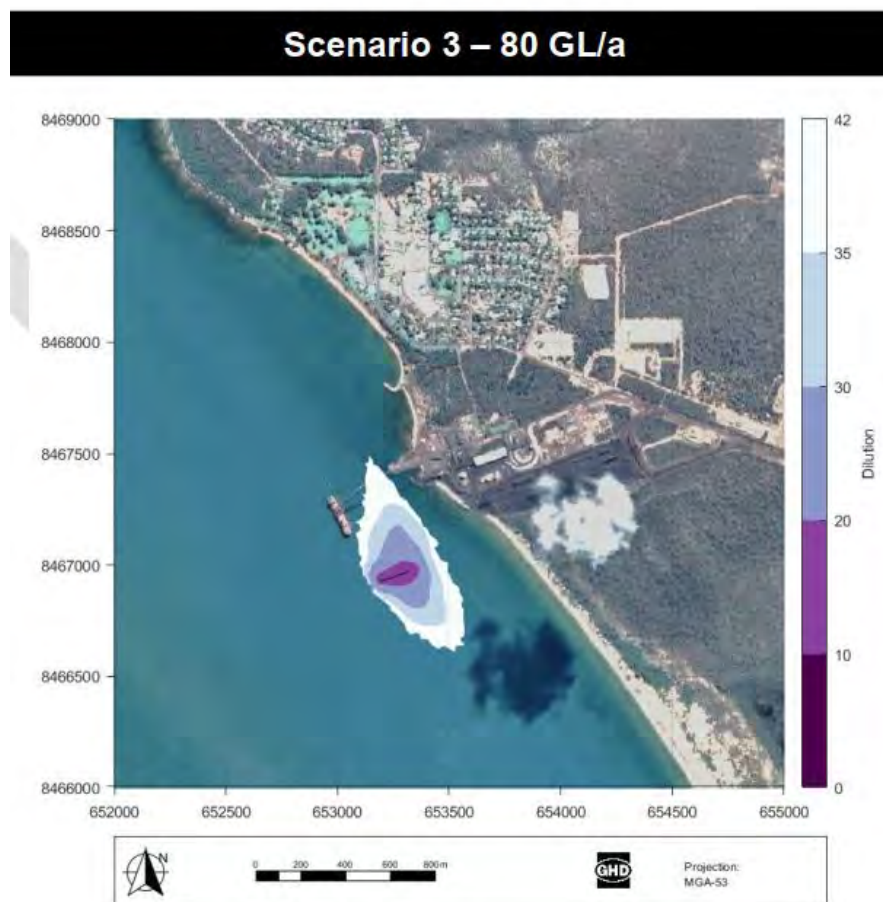


Figure 3-1 Scenario 3 - 80 GL/a dilution modelling

Video footage of the seafloor within the survey area was obtained using a small ROV with a live feed video camera connected via a tether line to a laptop on the survey vessel. Video files were saved in .mp4 format and the real-time ROV system details were saved as .ass files which can be encoded on to the .mp4 files as a subtitle. The beginning and end position of each transect was recorded as waypoints in WGS84 using a handheld GPS unit.

The ROV was deployed from a survey vessel to the north and south of the port within the survey area (Figure 2-1). The survey was designed to obtain video footage along transects at a bearing of 60° to the shore in an offshore to inshore direction, covering water depths of approximately 15 m to 1 m. However, the ability of the ROV to follow the preset transect direction and distance was dependent of the thrust power of the equipment to overcome the influence of the local water current and tidal movements.

Ultimately, video transects covered a range of distance, depths, and bearings, with the overall aim of providing the best possible coverage and survey effort (i.e., spatial distribution and survey time) of the survey area within the capabilities of the ROV and limitations of working within the coastal environment. The transects collected sufficiently covered the survey area to provide a primary understanding of the types and distribution of marine benthic habitats and to achieve the survey purpose.

The habitat mapping transects coordinates are included in Appendix A.

3.2 Remotely Operated Vehicle

Surveys were completed using the BlueROV2. This ROV has a 6-thruster vectored configuration, and open-source electronics and software (Figure 3-2). The ROV is used to take underwater footage of aquatic environments and is controlled by a ROV pilot using a handheld gaming controller (Xbox controller) and laptop using QGroundControl software.



Figure 3-2 The BlueRov2 show the front (left), side (centre) and underside and thrusters (right) of the ROV.

At the front of the ROV is a high definition (1080p, 30fps) wide-angle low-light camera optimised for use on the ROV. It is mounted to a tilt mechanism so that the pilot can control the camera tilt to look up or down when the ROV is level. WSP also attached a secondary camera to the outside of the battery chamber cap. This camera could not be tilted remotely but could be adjusted by the field operators before deployment, including in a downward facing position that cannot be achieved by the primary camera. During the survey at Groote Eylandt, the field team determined that the secondary camera was most effective for obtaining the best possible quality footage at an angle of approximately 45° relative to the upright position.

The ROV is configured with four dimmable Lumen Lights, providing up to 6,000 lumens to illuminate the underwater view. This light source was regularly altered by the pilot to account for the relatively low visibility of the survey site. The visibility underwater at the site was approximately 0.5 m during most of the field survey. The visibility was diminished by a notable amount of suspended sediment within the water column, which was also noted to be present as a fine silt layer on the sediment surface and on seabed vegetation.

The ROV uses T200 Thrusters in a vectored configuration, providing a high thrust-to-weight ratio and the ability to move in forward, reverse, up, down, clockwise and counterclockwise directions. The ROV has six thrusters and adjustable gain levels. The ROV is rated for up to 300 m water depth and has a 300 m tether.

The BlueROV2 is controlled by the Navigator Flight Controller and BlueOS. The Navigator is a purpose-built controller for ROVs and other robotic applications that has onboard sensors including an inertial measurement unit (IMU) and magnetometer to measure orientation and compass heading and a leak sensor to alert for water ingress. It has 16 outputs that can be connected to thrusters, lights, grippers, and other accessories as well as serial and I2C communication ports to communicate with sensors and sonars.

The Navigator is coupled with a Raspberry Pi 4 computer, which handles the processing and computing requirements within the ROV. It runs open-source BlueOS software that provides the tools and features necessary to operate the vehicle. BlueOS runs the ArduSub vehicle control software and manages the camera and tether connection. At the surface, the pilot controls the ROV through a laptop computer and gamepad controller. The open-source QgroundControl application acts as the user interface, providing the live video stream, sensor feedback and information, and the ability to change settings and configuration.

Prior to underwater deployment the field team runs through an extensive series of tests and calibration measures to ensure the ROV is watertight and the delicate electronics within the watertight chambers are functioning correctly. Pre-flight checks include calibrating two internal compasses, camera operation and tilt, thruster power in all directions, light levels, tether connections, and connectivity between the ROV and laptop using the relevant software and the ROV's own connection network. The seals of the battery and electronics chambers is tested using a hand operated vacuum pump. Given the sensitivity of the equipment and the delicate wiring within the ROV, an initial thorough calibration is particularly important after any land or air travel. These initial calibrations take several hours prior to heading out on site and then daily calibrations are required throughout the course of the fieldwork.

3.3 Post-production Processing

The video footage was saved in real time onto the field laptop during the survey. On completion of the fieldwork, the video files were processed prior to assessment of the ecological conditions shown in the footage.

Post-production processing involved 'burning in' the system information recorded in the .ass files onto the .mp4 files, to enable the information to be visible onscreen during analysis of the footage. This process was undertaken using the video transcoder software, HandBrake. This software is an open-source tool for converting video into widely supported codecs, including burning in subtitles, meaning the information is saved within the .mp4 file for each video, rather than requiring viewer software to access and display both files simultaneously. This process means the file package uses up less memory space and any viewing software can be used to watch the videos with embedded system information (as subtitles).

Post-production processing also involved stitching together .mp4 files when more than one video file was collected for a single transect. The ROV is equipped with two cameras allowing the pilot to switch between two views when operating the ROV, however new .mp4 and .ass files are created each time the cameras are switched, resulting in multiple .mp4 and .ass files for each transect. Microsoft's Clipchamp was used for stitching together files to produce one .mp4 file per transect. This process also reduced the amount of memory space required to play, store and transfer the video footage.

3.4 Video Analysis

Each video file was reviewed at normal (x1) speed or slowed to half (x0.5) speed to re-examine items of interest. An initial overview of the videos was undertaken to establish a variety of habitat types based on key ecological characteristics. These characteristics included:

- The type and texture of the substrate (e.g., sand, silt, soft, hard)

- Visible patterns/features of the substrate (e.g., bioturbation, ripples)
- The presence/absence, relative abundance, and type of epifauna (e.g., plants and animals living on top of the sediment)
- Any other distinguishing features of ecological importance observed by the reviewer.

Bioturbation is the result of marine organisms manipulating the substrate to produce their preferred habitat conditions (i.e., burrows, mounds created by infauna organisms that live within the substrate), animal waste, or the result of animals moving over the substrate (i.e., trails or 'footprints'). Bioturbation is also referred to as 'lebensspuren' which translates as 'life traces'.

The video footage for each transect was then reviewed in its entirety to determine the spatial extent and distribution characteristics of each habitat type. Changes in habitat type along the transect path were recorded using the play time of the video clip. The time records were then converted to an approximate distance along to the length of the relevant transect to provide an indication of the spatial extent of the various habitats.

The presence of the various habitat types along the transect alignments was used to extrapolate, using professional judgement and experience in habitat mapping, to the overall spatial distribution of seabed habitats within the survey area.

3.5 Cultural Significance

Information from the Traditional Owners was obtained by GEMCO and provided to WSP on 25 October 2024.

The information gained from the Traditional Owners did not raise matters that related specifically to the habitat mapping area. Their use of the marine environment is further afield within the wider context of the islands' coastal environment and will be discussed within the baseline report.

The purpose of this report is to provide the results of the habitat mapping; the analysis of the Traditional Owners information within the context of the project and wider marine environment will be undertaken in the marine baseline report.

4 Marine Habitats

There is a distinct sequence in habitat types with water depth within the study area. This sequence was clearly observed along the progression of the survey transects from subtidal to intertidal zones. Transects typically started at depths of 10-15 m and followed a path with a bearing of approximately 60° to a depth of 0.5 m at which point the ROV could not progress further in the shallow water.

Overall, the sequence of the habitats from subtidal to intertidal zones was largely consistent throughout the study area, with the exception of the reef structures which were predominantly present in closest proximity to the Milner Bay Port.

The habitat map is included in Appendix B.

Key observations included:

- Extensive bioturbation within the soft mud and silt habitat in the subtidal depths.
- The substrate gradually changed from mud/silt to gravelly sand closer to shore. Rubble and gravels on mud or sand were more common where epibiota was densest.
- Epibiota increased in cover, abundance and diversity from deeper to shallower zones.
- Fish were typically observed in close proximity to clumps of epibiota or the coral reef structures.
- Seagrass was relatively sparse within the study area.

The following habitat types and small-scale variations in these habitats were identified during the habitat mapping survey. There are two components to consider when discussing habitat types: the characteristics of the seafloor substrate and of the biota (plants and animals) using these substrate types.

4.1 Silt and mud substrate

The deepest areas of the study area were typically devoid of conspicuous epibiota (organisms living on the sediment surface). However, there was obvious evidence of infauna living within the soft sediment. This evidence is described as bioturbation as the infauna create burrows, larger pits and mounds of sediment while manipulating the sediment to their preferred habitat type. The degree of bioturbation varied from occasional burrows or pits within a level (i.e., flat) soft substrate to substrate that was highly modified by infauna resulting in a very 'lumpy' seabed. The marine species creating these features were not observed during the ROV survey but are typically composed of prawn-like crustaceans (i.e., scampi, prawns, shrimp, or other small 'lobster-type' species). It is also possible that marine worm species (i.e., polychaete species) are contributing to the disrupted seabed as many of these species are commonly found as benthic infauna. There may also be the presence of burrowing anemones, molluscs (bivalves and gastropods), and fish that use or create indentations in the seafloor. Figure 4-1 includes a schematic example of bioturbation and the general taxonomic groups that contribute to this habitat type.

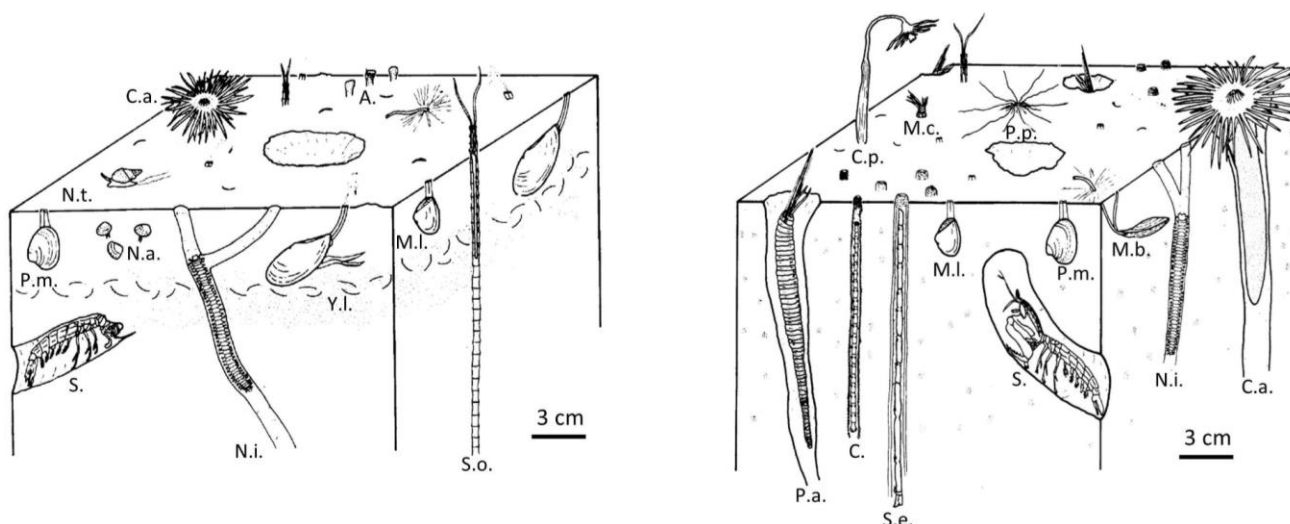


Figure 4-1 Schematic illustrations of major faunal components and life habits of benthic communities typically found in shallow water (<20 m) (left) and deep water (>20 m) regions (right) of the central basin of Long Island Sound (adapted from Aller, 1980).

4.2 Sand substrate

The seabed in shallower depths less than 5 m was predominantly sand and/or some gravels. This substrate occurs between rocky coral boulders and reefs, and with the intertidal zone where it is rippled from wave action. This sandy habitat is devoid of epibiota, with the exception of the boulders that support corals and other epifauna.

4.3 Hard substrate and coral reef

There are boulders and small reef structures within the shallow subtidal zone. It is not clear whether these formations are primarily created from coral cover or from epibiota (including coral species) colonising rock or boulder features. Regardless of the formation, this substrate supports the most diverse combination of marine epibiota, including corals, bryozoans, hydroids, ascidians and algae (specifically red algae, Rhodophyta). Several small fish were observed in this area and these habitats are well known to provide refugia for juvenile or reef-based fish species.

4.4 Caulerpa-like benthic cover

This habitat is characterised by the presence of a green plant species growing either as small patches of sparse cover or up to 100% cover with a notable tangle of leaves and branches. The genus *Caulerpa* is highly diverse. Currently, more than 100 species are recognised worldwide. Despite recent advances in taxonomy and phylogeny, there is still confusion about the delimitation and identification of some species due to tremendous phenotypic plasticity. *Caulerpa* is known to occupy a wide range of environmental niches and to have great invasive potential. Figure 4-2 shows the forms of *Caulerpa* spp.

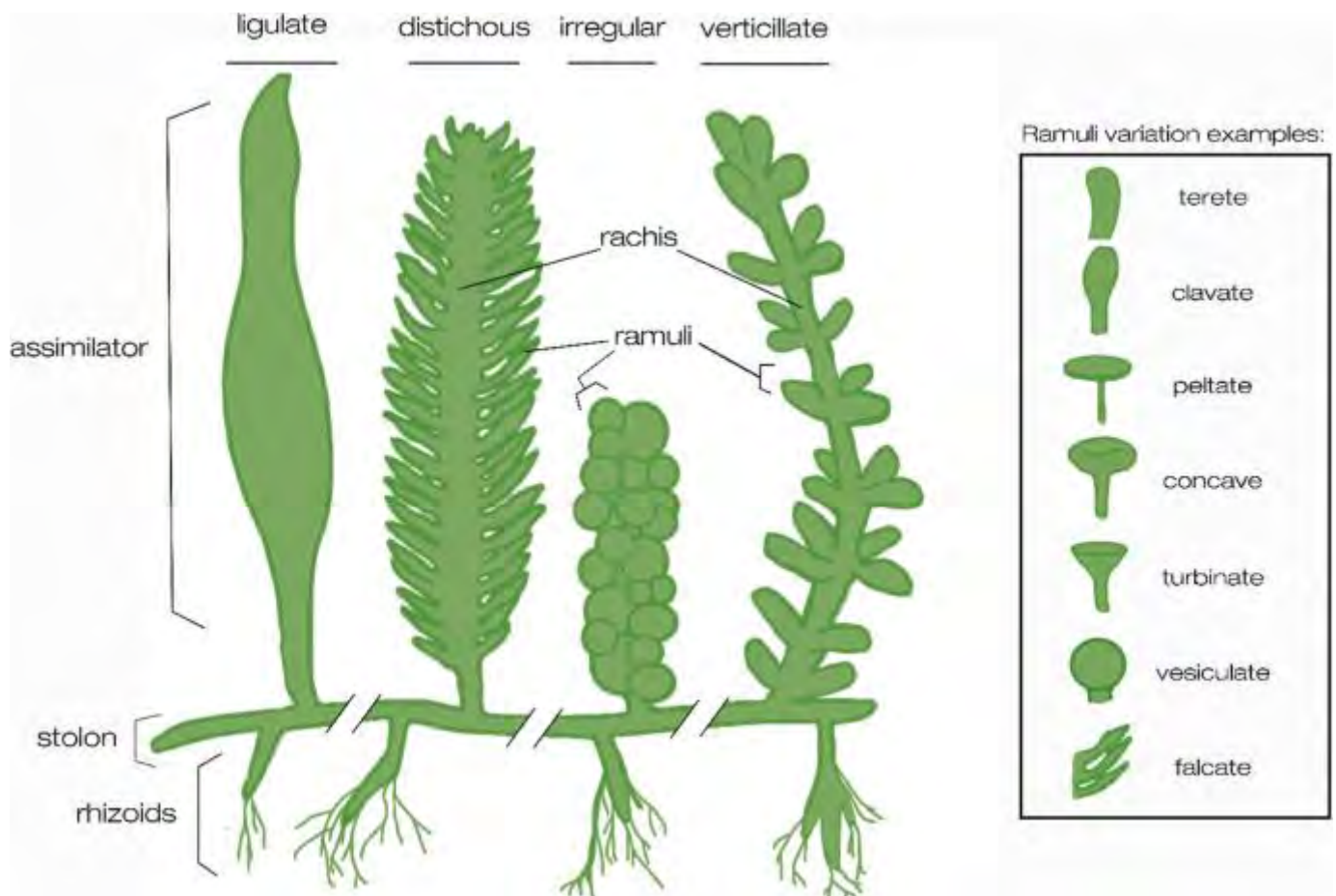


Figure 4-2 Schematic diagram of *Caulerpa* formations. The distichous form has similar features to the benthic vegetation observed in the study area for habitat mapping.

This habitat was found at many depths with the densest cover occurring at the mid-depths of the transects, at approximately 5 m depth or less. This vegetation was present on the soft mud/silt sediments of the deeper zone as well as on the sandier substrates that were observed in shallower parts of the study area. This vegetation was typically observed as a monoculture patch with the occasional mound from bioturbation noted within the tangle of plants.

4.5 Epibiota

In addition to the *Caulerpa*-type species and coral reef species, epibiota was often observed at varying densities throughout the transects. The abundance and diversity of epibiota generally increased along the transects moving from deeper water to shallow beach habitat. In deeper water the epibiota was usually singular, flat, encrusting species such as colonial ascidians (sea squirts), possibly burrowing anemones, and algae. As the depth decreased, the epibiota became more diverse, in larger 'clumps' including erect species, and covering more of the seabed. The epibiota included branching species such as hydroids, corals, bryozoans, and algal (especially red algae). The occasional individual star fish sea cucumber and sea pen were observed.

4.6 Seagrass

Seagrass was not a particularly prominent feature within the study area. At shallower depths less than 5 m, individual to a sparse cover of seagrass sprouts were observed, sometime amongst the *Caulerpa*-like vegetation and/or other epibiota. The densest patches of seagrass were observed in the shallows of Transects P, Q, O and L.

5 Conclusions

The information on benthic habitats gained from the ROV survey provide a sufficient basis on which to focus the desktop baseline assessment for marine ecology for approvals.

While the visibility was limited by suspended sediment and turbidity, WSP was able to identify and describe the key features of the seafloor substrates and epibiota present on the seabed.

The application of the marine habitat mapping can be used to inform the desktop baseline marine assessment and may include:

- Integrating the habitat mapping information into the desktop baseline marine ecology assessment.
- Preliminarily identifying the species and/or family of the taxa observed where greater detail is required for the desktop baseline assessment.
- Identifying the most appropriate corridor for the proposed pipeline.
- Discussing the potential effects on marine ecology from the presence and construction methodology for laying the pipeline.
- Further marine surveys if more detailed assessments of the species presence or abundance is required over and above the habitat communities described herein. Field sampling could include benthic core samples to examine the infauna present in soft sediment habitats, sample collection of marine vegetation to confirm the genus and species present, and trawls with a naturalists dredge to identify the epibiotic species in the study area.

6 Limitations

This Report is provided by WSP Australia Pty Limited (WSP) for South32 & GEMCO (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated 12/12/2022, and the conditions of PO 4542525680 with the Client dated 19/12/2022.

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7 References

GEMCO Excess Water Disposal Project - Marine Discharge Modelling report, GHD, 6 October 2023.

Zubia, M, Draisma, S., Morrissey, K., Varela-Álvarez, E., De Clerck, O. (2019) Concise review of the genus *Caulerpa* J.V. Lamouroux. *Journal of Applied Phycology* 32 : 23–39.

DRAFT

Appendix A

Habitat Mapping Transects Coordinates





Habitat Mapping Transect Coordinates

Transect Identifier			
A	Start	13° 51.463'S	136° 24.867'E
	End	13° 51.394'S	136° 25.060'E
B	Start	13° 51.521'S	136° 24.921'E
	End	13° 51.422'S	136° 25.084'E
C	Start	13° 51.412'S	136° 25.040'E
	Mid	13° 51.435'S	136° 25.010'E
	End	13° 51.551'S	136° 24.935'E
D	Start	13° 51.572'S	136° 24.957'E
	End	13° 51.480'S	136° 25.080'E
E	Start	13° 51.761'S	136° 24.886'E
	End	136° 24.886'E	136° 25.085'E
F	Start	13° 51.802'S	136° 24.925'E
	End	13° 51.597'S	136° 25.194'E
G	Start	13° 51.850'S	136° 24.883'E
	End	13° 51.682'S	136° 25.177'E
H	Start	13° 51.873'S	136° 24.914'E
	Mid	13° 51.772'S	136° 25.040'E
	End	13° 51.684'S	136° 25.339'E
I	Start	13° 51.913'S	136° 24.943'E
	Mid	13° 51.783'S	136° 25.151'E
	End	13° 51.678'S	136° 25.272'E
J	Start	13° 51.914'S	136° 24.959'E
	End	13° 51.795'S	136° 25.371'E
K	Start	13° 51.965'S	136° 25.017'E
	Mid	13° 51.828'S	136° 25.322'E
	End	13° 51.839'S	136° 25.390'E



Transect Identifier			
L	Start	13° 52.003'S	136° 25.071'E
	End	13° 51.899'S	136° 25.386'E
M	Start	13° 52.050'S	136° 25.143'E
	End	13° 51.851'S	136° 25.283'E
N	Start	13° 51.851'S	136° 25.283'E
	End	13° 51.830'S	136° 25.438'E
O	Start	13° 52.095'S	136° 25.245'E
	End	13° 51.778'S	136° 25.394'E
P	Start	13° 52.146'S	136° 25.280'E
	Mid	13° 52.130'S	136° 25.328'E
	End	13° 51.980'S	136° 25.544'E
Q	Start	13° 52.197'S	136° 25.277'E
	Mid	13° 52.060'S	136° 25.355'E
	End	13° 51.996'S	136° 25.562'E

Appendix B

Habitat Map





Figure B-1 Map showing location of transects covered by the ROV in September 2023.

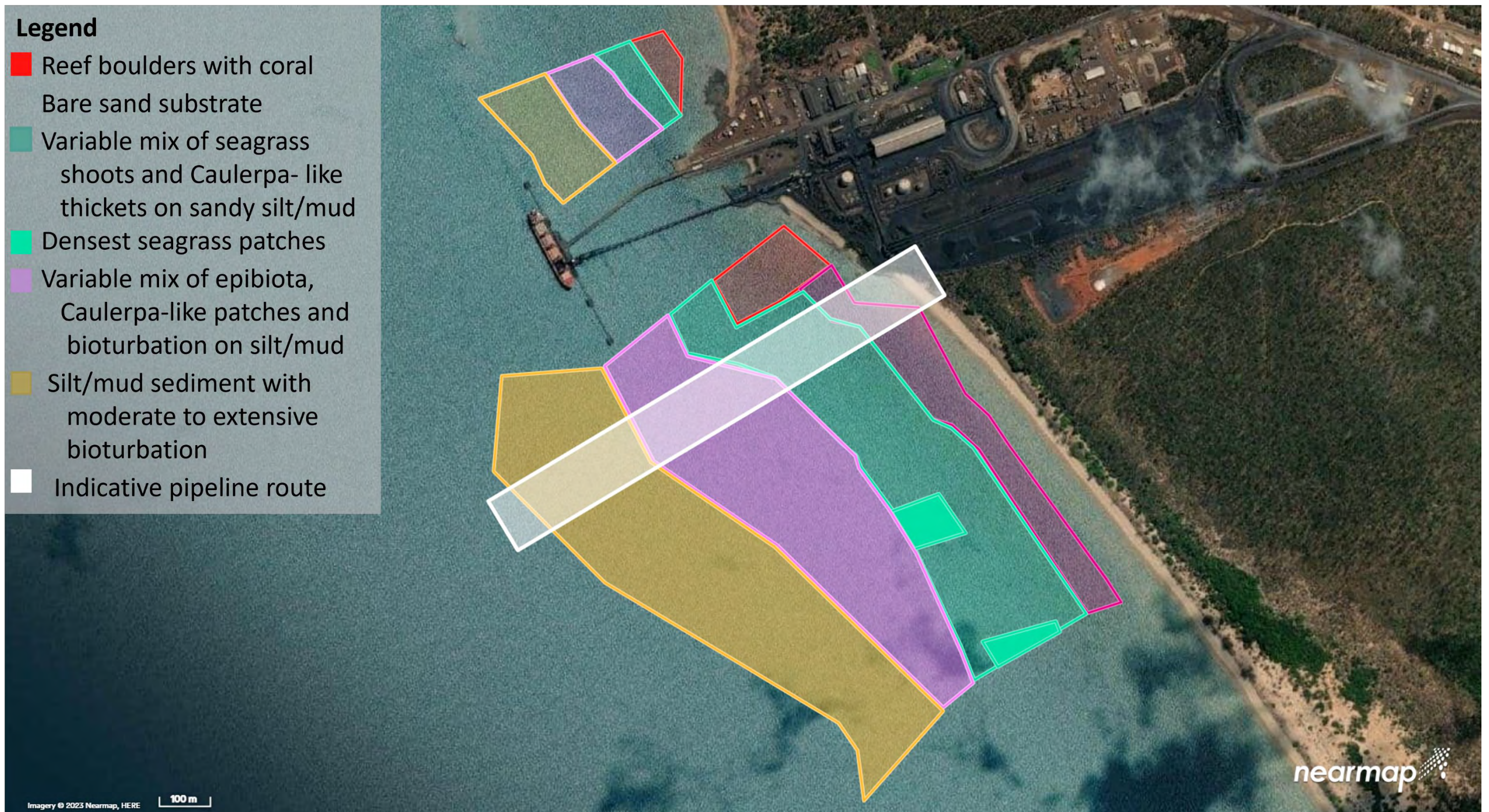


Figure B-2 Broadscale map of habitats in the vicinity of the proposed pipeline corridor and covering the potential extent of discharge dispersal.

Appendix E

**GHD Benthic Marine Habitat Survey
Technical Memorandum – June 2024**

Technical Memorandum – Marine Benthic Survey June 2024

06 September 2024

1. Introduction

GHD were commissioned by GEMCO to survey the marine habitat in and adjacent to the proposed ocean outfall footprint (the footprint). A previous marine habitat survey was undertaken by WSP in September 2023 (Summer survey). This survey was undertaken during the summer months where seagrass is likely to have the greatest presence. The Summer survey found sparse presence of seagrass throughout the nearshore environment within the footprint and survey area.

GHD were engaged to undertake a second field assessment of the survey area during winter months (June) to assess whether the seagrasses observed in September are seasonal. The GHD surveys were undertaken over 5th to 9th June 2024 (Winter survey) and also included opportunistic surface water and surface sediment sampling.

1.1 Purpose of this Memorandum

The purpose of the technical memorandum is to present the results of the marine habitat mapping field surveys conducted by GHD on 5th to 9th June 2024 as well as to present the *in situ* and laboratory water and sediment quality data.

1.2 Scope and limitations

This technical memorandum has been prepared by GHD for GEMCO. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

The survey was conducted in the winter months when seagrass may be dormant and therefore any absence of seagrass in the surveyed areas does not indicate that they do not exist. Surveys conducted during the summer months, typically November, are best to determine seagrass presence.

Distance estimates of habitat features relative to the marine footprint included herein are estimated based on spatial data files "SVY-GDW-013-Disturbance-Vegetation-Regrowth-Rev1-(2024-0709).dxf" and "SVY-GDW-014-Disturbance-Off-Lease-Access-(2024-0709).dxf" provided on 9 July 2024.

2. Methodology

A marine habitat survey (Section 2.1) was conducted over 5th to 9th June within the Project Area (Figure 1). Additionally, opportunistic water quality (Section 2.2) and sediment quality (Section 2.5) sampling was also undertaken over the course of the habitat survey.

2.1 Marine habitat survey

Survey transects were pre-defined according to the transects conducted by WSP in the previous September 2023 survey to enable comparison of like-for-like benthic habitat to assess for potential seasonal changes. Transect start and end coordinates were pre-programmed as waypoints into the vessel's onboard navigation system.

Marine habitat was assessed using a combination of vessel-based tow and drop camera video footage using a GoPro Hero7 and a DJI Osmo Action 4 camera mounted in a SpotX tow camera housing with 20 m umbilical power/data cable and live-video feed.

For towed transect footage, the camera + housing unit was lowered to approximately 2 m above the seabed. Recording was initiated remotely when the vessel reached the GPS coordinate denoting the start of the transect and continued to record for the duration of the transect (when the GPS waypoint denoting the transect end was reached). Footage was viewed in real time and presence of marine plants (seagrass/macroalgae) as well as any other features of interest (rock, coral, fauna etc) recorded.

Wherever visibility in the towed footage was restricted (i.e. out of focus, dark etc) or a point of interest was identified for further investigation, a drop camera was utilised to capture additional footage (Figure 2). Drop camera footage was taken by lowering the camera to approximately 2 m above the seabed with video recorded for approximately 20 seconds to sufficiently record the condition of the seabed.

All survey tracks and sampling points were recorded using the Avenza Maps (v5.3) software.

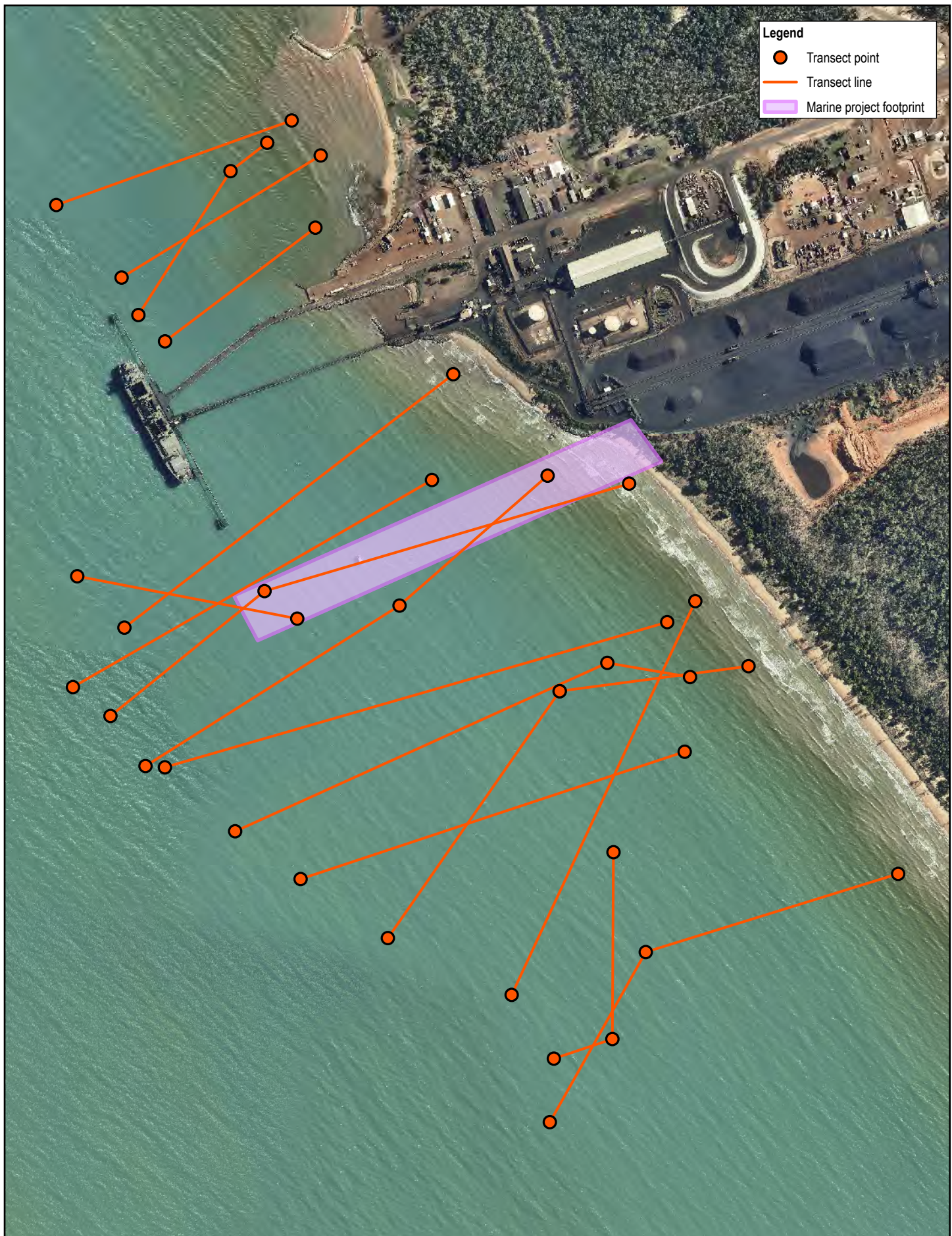
2.2 Water and sediment sampling

Water sampling was taken at approximately 30 cm depth using a pole with sampling container attached to the end. Water samples were then transferred to sample containers and placed on ice.

A van Veen grab capable of retaining approximately one litre (L) of sample was deployed by hand with rope from the side of the vessel to the seabed. A minimum of three replicate grabs were collected per sample location to ensure that the appropriate mass of sediment had been collected (~3 kg) and that the sediment was representative of the material to be assessed. If sufficient sediments were not retrieved in three attempts, additional grabs were conducted until the required volume was obtained.

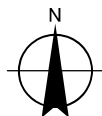
Upon recovery, sediment was placed into a decontaminated stainless-steel bowl and mixed by hand (using disposable nitrile gloves) to create a thoroughly homogenised sample and then transferred into laboratory-provide sample bags and jars. The retrieved sediment was also assessed for habitat features (e.g. seagrass, macroalgae or coral fragments).

QA/QC samples were also collected for intra-laboratory testing at a scale of one QA/QC sample for every 10 samples.



Paper Size ISO A4
0 50 100 150 200
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 53



South32 Group Operations Pty Ltd
GEMCO Excess Water Disposal Project

**Benthic habitat transects from
WSP survey (September 2023)**

Project No. 12624084
Revision No. A
Date 27/05/2024

FIGURE 1

2.3 Marine Habitat Transects

A total of 17 transects (labelled A-D (north of shiploader jetty); E-Q (south of shiploader jetty); Figure 2) were surveyed across the Project area. A summary of the benthic habitat observed during each transect survey is provided in Table 1; representative imagery captured from the footage from each transect is provided in Attachment 1. Figure 2 provides a map of the benthic habitat recorded during the survey.

Generally, the benthic habitat in the survey area was found to consist of:

- Predominantly open sandy substrate with infauna burrows and evidence of bioturbation throughout the survey area including in the footprint (Image 1; Table 1; Figure 2)
- Occasional marine fauna observations including various common fish species (i.e. Trevally, stingray (unknown spp) and sea stars (unknown spp)) (Image 2; Table 1; Figure 2).
- Individuals blades of *Halophila ovalis* seagrass observed approximately 310 m south of the footprint along Transect N (Image 3; Table 1; Figure 2)
- Rocky coral reef with dense macroalgae south of the ship-loader jetty in nearshore zone approximately 130 m north of the footprint at the end of Transect F and G (Image 4; Table 1; Figure 2)
- Small patches of rocky reef hosting variety of hard and soft corals, polychaetes and macroalgae, as well as occasional individual coral colonies, were observed approximately 560 m south of the footprint along Transects O and P (Image 5; Table 1; Figure 2)
- Tyres, plastic and other waste items observed on substrate north of the ship-loader jetty along Transect D (Image 6; Table 1; Figure 2)

Additionally, the field team observed a loggerhead turtle within the Project area in proximity to the tugboat day mooring.

Table 1 Summary of marine habitat observed during transect surveys

Transect	Habitat summary	Cross-refs (Attachment 1)
Transect A	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows. Occasional rocky patches with coral colonies in nearshore area.	Plate 1 to Plate 4
Transect B	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows. Small coral garden at start of transect.	Plate 5 to Plate 8
Transect C	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows.	Plate 9 to Plate 12
Transect D	Predominately sandy substrate. Occasional shell debris observed. Numerous items of rubbish observed including tyres and solid plastic waste.	Plate 13 to Plate 16
Transect E	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows.	Plate 17
Transect F	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows. An extensive coral garden is present in the nearshore zone, transitioning to rocky reef with dense macroalgae in shallower areas.	Plate 18 to Plate 20
Transect G	Predominately sandy substrate. Occasional shell debris observed. Transitioning to patches of individual corals and rocky reef with macroalgae in the nearshore zone at the end of the transect.	Plate 21 to Plate 23
Transect H	Predominately sandy substrate. Occasional shell debris observed as well as numerous infauna burrows.	Plate 24 to Plate 27
Transect I	Sandy substrate with rocky outcrops closer to shore supporting a variety of coral colonies. Shell debris and crab holes were seen	Plate 28 and Plate 31

Transect	Habitat summary	Cross-refs (Attachment 1)
	throughout the sandy substrate from over 100 m from shoreline. Various waste/rubbish items were recorded throughout the transect.	
Transect J	Predominately sandy substrate. Occasional shells were seen and infauna burrows were observed.	Plate 32 and Plate 33
Transect K	Habitat presented as sandy substrate, patches of macroalgae were recorded occasionally along the transect, with occasional gravelly habitat. Large infauna burrows present throughout.	Plate 34 to Plate 36
Transect L	Overall the transect consisted predominately of sandy substrate. Occasional shells were observed while infauna burrows were common throughout.	Plate 37 and Plate 38
Transect M	Predominantly sandy substrate closer to shore and then transitioning to gravelly substrate with patches of rocky habitat with macroalgae as distance from shore increased.	Plate 39 to Plate 42
Transect N	Predominantly sandy substrate with burrows of infauna present. Patches of rocky habitat were also observed. A small grouping of a few individual blades of <i>H. ovalis</i> were observed along the transect approximately 310 m south of the footprint.	Plate 43 to Plate 45
Transect O	The most diverse transect in terms of benthic habitats observed. Beginning as a sandy substrate, the habitat transitioned to predominantly rocky habitat / coral gardens supporting communities of sponges, sea fans, and a number of coral species including reef building scleractinian corals. These coral gardens are located approximately 500 m south of the footprint.	Plate 46 to Plate 49
Transect P	Initial sandy substrate which transitioned to a small rocky coral garden approximately 560 m south of the footprint, which then transitioned back to sandy substrate with small patches of individual corals being observed including <i>Platygyra</i> spp.	Plate 50 to Plate 52
Transect Q	Predominately sandy substrate. Occasional shells were observed while infauna burrows were common throughout. Occasional coral colonies observed on rocks scattered through the benthic landscape.	Plate 53 and Plate 54 Tow camera footage of seabed at start of transect and ended as sandy substrate with shell and crab holes. Right image shows coral growth. Plate 54





Image 1 Open sandy substrate with infauna burrows dominated much of the benthic habitat in the survey area



Image 2 Stingray on open sand substrate spotted south side of the Port along Transect I



Image 3 Individuals of H. ovalis observed in along Transect N

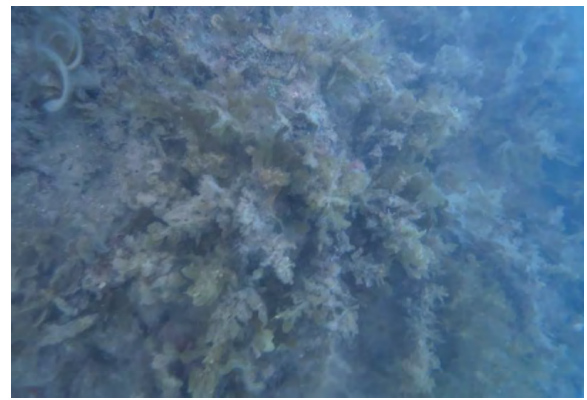


Image 4 Dense macroalgae on rocky reef in the nearshore zone at the end of Transect F



Image 5 Coral garden along Transect F



Image 6 Rubbish (plastic bin, tire, rope) found along Transect D

2.4 Water Quality

2.4.1 Physiochemical (*In situ*)

In situ water quality monitoring was conducted at 11 sites across the Project area on 9 June 2024 (Attachment 2). Samples I1 – 5 were taken inside the Project area and C1 – 6 were taken around the Project area. General observations from in-situ parameters measured are as follows:

- Water temperature was consistent across all monitoring locations with an average of 24.6 °C
- Dissolved oxygen was consistently high across all monitoring locations with an average of 100.2 % saturation and 7.17 mg/L
- Conductivity remained consistent between all monitoring sites with an average of 41,717 µS/cm.
- Trends in pH were consistent across all monitoring locations with an average of 8.07 pH units.
- Turbidity (recorded at the surface) was consistent across all monitoring sites with an average of 2.52 NTU.

2.4.2 Nutrients

Water samples were collected at 10 sites (I1 – 4 and C1 –6) and sent to a laboratory to test for nutrient levels (Attachment 3). Samples I1 – 4 were taken inside the Project area and C1 – 6 were taken around the Project area. Those nutrients detected above the respective Limit of Reporting (LOR; Table 2) are summarised as follows:

- Ammonia (as N) was detected in all samples, ranging between 0.08 - 0.16 mg/L, with an average and median concentration of 0.1 mg/L
- Nitrate (as N) had one detection at 5.21 mg/L (sampling site I1)
- Nitrogen (total oxidised) had one detection at 5.21 mg/L (sampling site I1)
- Total Nitrogen (Total N) had one detection at 5.20 mg/L (sampling site I1)
- Total Phosphorous (Total P) had one detection at 0.07 mg/L (sampling site C5)
- Reactive phosphorous (as P), Nitrite (as N) and Total Kjeldahl Nitrogen (TKN) were not detected in any samples

Of note, matrix interference was encountered during the laboratory analyses for Total P, Total N and TKN which resulted in samples requiring dilution and their LORs subsequently adjusted by the laboratory from 0.01 mg/L to 0.05 mg/L for Total P, and from 0.1 mg/L to 0.5 mg/L for Total N and TKN. This likely contributed to the lack of detections for these analytes.

Table 2 Water Quality Summary Laboratory Results – Detected Nutrients

	Ammonia as N	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Phosphorus (Total)
Units	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	0.01	0.01	0.01	0.1	0.01
Adjusted LOR	-	-	-	0.5	0.05
Number of Results	10	10	10	10	10
Number of Detects	10	1	1	1	1
Minimum	0.08	5.21	5.21	5.20	0.07
Maximum	0.16	5.21	5.21	5.20	0.07

	Ammonia as N	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Phosphorus (Total)
Average Concentration*	0.1	0.53	0.53	0.74	0.03
Median Concentration*	0.1	0.005	0.005	0.25	0.025

* A Non-Detect Multiplier of 0.5 has been applied

- not applicable

2.4.3 Metals and metalloids

No metal/metalloid analytes were recorded above the respective LORs in any samples. Water samples were laboratory tested for metals and metalloids however matrix interference was encountered during the laboratory analyses for all metals which resulted in samples requiring dilution and their LORs subsequently adjusted from the requested LOR (0.001 mg/L) by the laboratory, this increase was above the trace concentrations historically recorded in the MEMP. The adjusted LORs were:

- Arsenic, Cadmium, Chromium, Lead, Mercury: adjusted LOR: 0.005 mg/L for all
- Zinc: adjusted LOR: 0.025 mg/L

All samples from this monitoring event returned values less than the adjusted LOR.

2.4.4 Additional contaminants

Water samples were also tested for additional contaminants, namely:

- BTEXN / volatile organic compounds (VOCs): Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
- Total Recoverable Hydrocarbons (TRH)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Phenols (halogenated and non-halogenated)
- Organochlorine (OC) and Organophosphate (OP) pesticides
- Polychlorinated Biphenyls (PCBs)

Of these additional analytes, no detections were observed above their respective LORs (Attachment 3).

2.5 Sediment Quality

2.5.1 Particle size distribution

Sediment samples were collected at six sites around the Project area (C1 – 6) for particle size analysis (Table 3; Attachment 4). The particle size distributions were relatively similar across sites (Figure 3), with the following findings:

- Sand (0.06 – 2.00 mm) dominated the sediment composition at all sites, ranging from 72 – 96%, with an average of 81%
- There were low levels of gravel (>2 mm) across all samples, ranging from 2 – 17%, with an average of 8.4%
- Trace amounts of fine sediments (clay (<2 µm) and silt (2 – 60 µm)) were present in most samples, contributing on average 8.2% and 2.5%, respectively.
- Cobbles (>6 cm) were not present in any samples

Table 3 Particle size distribution summary statistics for sediment samples

	Gravel (>2 mm)	Sand (0.06-2.00 mm)	Silt (2-60 µm)	Clay (<2 µm)
Units	%	%	%	%
LOR	1	1	1	1
Number of Results	5	5	5	5
Number of Detects	5	5	4	5
Minimum % concentration	2	72	1	2
Maximum % concentration	17	96	5	12
Average Concentration*	8.4	81	2.5	8.2
Median Concentration*	7	77	3	8

* A Non Detect Multiplier of 0.5 has been applied to all values below the LOR for the purpose of median calculations.

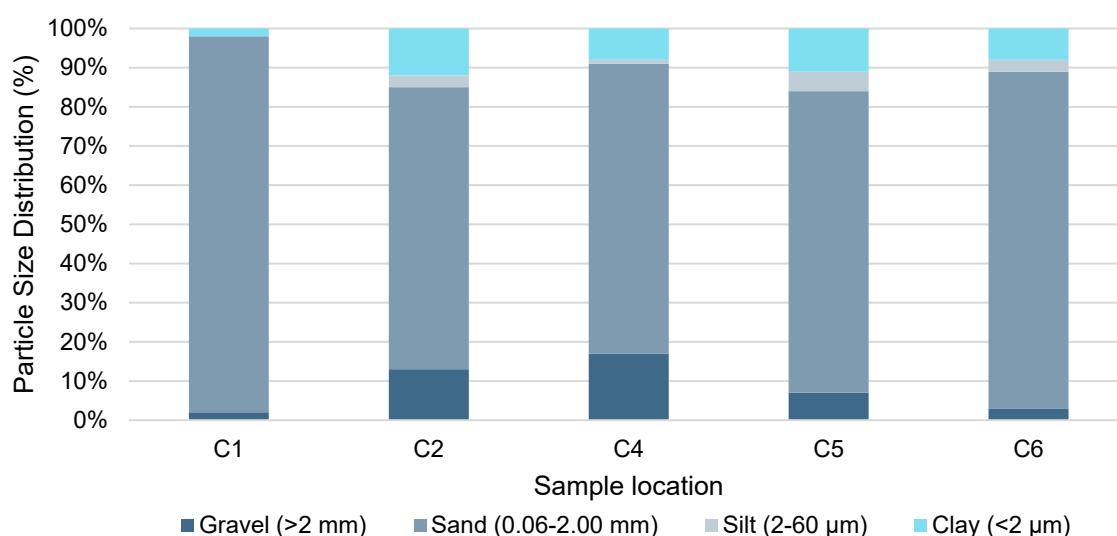


Figure 3 Summary particle size distribution results for sediment sampling locations

2.5.2 Nutrients

Nutrient samples were collected at 10 sites (C1 – 6, and I1 – 4) (Attachment 4). Nutrients detected above the respective LOR (Table 4) are summarised as follows:

- Nitrate was detected in most samples, ranging between 0.2 – 4.2 mg/L, with an average concentration of 1.3 mg/kg
- Total oxidised nitrogen was detected in most samples, ranging between 0.2 – 4.2 mg/kg, with an average concentration of 1.3 mg/kg
- Total nitrogen was detected in most samples, ranging from 70 – 460 mg/kg, with an average concentration of 181 mg/kg
- Kjeldahl total nitrogen was detected in most samples, ranging from 70 – 460 mg/kg, with an average concentration of 181 mg/kg
- Phosphorous (Total) was detected in all samples, ranging from 62 – 241 mg/kg, with an average concentration of 128 mg/kg
- Reactive phosphorus was detected in most samples, ranging from 0.2 – 0.4 mg/kg, with an average concentration of 0.17 mg/kg

Samples also underwent analysis for Ammonia and Nitrite but these analytes were not detected in any samples.

Table 4 *Sediment Summary Laboratory Results – Detected Nutrients*

	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Phosphorus (Total)	Reactive phosphorus (as P)
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	0.1	0.1	20	20	2	0.1
Number of Results	10	10	10	10	10	10
Number of Detects	7	7	9	9	10	6
Minimum	0.2	0.2	70	70	62	0.2
Maximum	4.2	4.2	460	460	241	0.4
Average Concentration*	1.3	1.3	181	181	128	0.17
Median Concentration*	1.15	1.15	135	135	109.5	0.2

* A Non Detect Multiplier of 0.5 has been applied.

2.5.3 Metals and metalloids

Sediment samples were laboratory tested for metals and metalloid concentrations (Attachment 4). Those contaminants detected above the respective LOR (Table 5) are summarised as follows:

- Arsenic was detected in most samples, ranging from 6 – 14 mg/kg with an average concentration of 7.1 mg/kg
- Chromium (III + VI) was detected in all samples, ranging from 6 – 22 mg/kg with an average concentration of 13 mg/kg
- Nickel was detected in one sample at 3 mg/kg
- Zinc was detected in two samples at 8 mg/kg and 9 mg/kg

Samples also underwent analysis for Cadmium, Copper, Lead and Mercury, but these analytes were not detected in any samples. All metal/metalloid analytes were below guideline values

Table 5 *Sediment Summary Laboratory Results – Detected Metals and Metalloids*

	Arsenic	Chromium (III+VI)	Nickel	Zinc
Units	mg/kg	mg/kg	mg/kg	mg/kg
LOR	5	2	2	5
Number of Results	10	10	10	10
Number of Detects	8	10	1	2
Minimum	6	6	3	8
Maximum	14	22	3	9
Average Concentration*	7.1	13	1.2	3.7
Median Concentration*	6	13.5	1	2.5

* A Non-Detect Multiplier of 0.5 has been applied.

2.5.4 Additional contaminants

Sediment samples were also tested for additional contaminants (BTEXN, TRH, Phenols, OC/OP, PCBs and PAHs). For these additional analytes, no detections were observed above their respective LORs (Attachment 4).

2.5.5 Potential Acid Sulphate Soils

Sediment samples were laboratory tested against the Potential Acid Sulphate Soil (PASS) suite at one site outside the footprint (C3) and four sites within the footprint (I1 – 4) (Attachment 4). The interpretation of the results were:

- No Actual Acid Sulfate Soils (AASS) were present, only PASS
- Excess Acid Neutralising Capacity (ANC) was identified such that the sediment is considered to be self-neutralising
- Overall there is a low risk of contaminant mobilisation due to acidification, aligning with the conclusions of the GEMCO Tug Replacement Project (Indo-Pacific, 2022)

The PASS parameters detected above the respective LOR (Table 6) are summarised as follows:

Field tests:

- pHF was detected in all samples, ranging from 8.4 – 8.6 pH units, with an average pH of 8.5
- pHFox was detected in all samples, ranging from 6.6 – 9.9 pH units, with an average pH of 9.1
- Reaction ratings was detected in all samples, ranging from 2 – 4 with an average of 2.4 (no units)

pH:

- pHKCl was detected in all samples with a minimum and maximum detection of 9.4% and an average and median concentration of 9.6%.

Acidity Trail (Table 6):

- Chromium Reducible Sulphur (acidity units) was detected in three samples with a minimum and maximum detection of 10% and average and median concentration of 13%.
- Chromium Reducible Sulphur was detected in all samples with a minimum and maximum detection of 0.01% and an average and median concentration of 0.021%.

ANC (Table 6):

- Acid Neutralising Capacity (acidity units) was detected in all samples with a minimum and maximum detection of 2,680% and an average and median concentration of 4,830%.
- Acid Neutralising Capacity (sulfur units) was detected in all samples with a minimum and maximum detection of 4.29% and an average and median concentration of 7.75%.
- Acid Neutralising Capacity was detected in all samples with a minimum and maximum detection of 13.4% and an average and median concentration of 24.2%.

Acid Base Accounting (Table 6):

- Net Acidity (Acidity units) excluding ANC was detected in three of the samples with a minimum and maximum detection of 10% and average and median concentration of 13%.
- Net Acidity (sulphur units) excluding ANC was detected in one sample measuring 0.02%.
- ANC Fineness Factor was detected in all samples with a minimum and maximum detection and an average and median concentration of 1.5%.

No detection

- Titratable Actual Acidity, Titratable Actual Acidity (sulphur units), Net Acidity (acidity units), Net Acidity (sulphur units), Liming Rate and Liming Rate excluding ANC were not detected.

Table 6 **Sediment Summary Laboratory Results – Detected PASS analytes**

	Field			pH	Potential Acidity		Acid Neutralising Capacity			Acid Base Accounting		
	pHF	pHFox	Reaction Ratings*	pHKCl	Chromium Reducible Sulphur (acidity units)	Chromium Reducible Sulfur	Acid Neutralising Capacity (acidity units)	Acid Neutralising Capacity (sulfur units)	Acid Neutralising Capacity	Net Acidity (Acidity Units) excluding ANC	Net Acidity (Sulfur Units) excluding ANC	ANC Fineness Factor
Units	pH units	pH units	-	pH	mole H+/t	% S	mole H+/t	% S	% CaCO ₃	mole H+/t	% S	-
LOR	0.1	0.1	1	0.1	10	0.005	10	0.01	0.01	10	0.02	0.5
Number of Results	5	5	5	5	5	5	5	5	5	5	5	5
Number of Detects	5	5	5	5	3	5	5	5	5	3	1	5
Minimum	8.4	6.6	2	9.4	10	0.01	2,680	4.29	13.4	10	0.02	1.5
Maximum	8.6	9.9	4	9.6	13	0.021	4,830	7.75	24.2	13	0.02	1.5
Average Concentration*	8.5	9.1	2.4	9.5	8.6	0.015	4,028	6.5	20	8.6	0.012	1.5
Median Concentration*	8.5	9.8	2	9.4	10	0.016	4,120	6.6	20.6	10	0.01	1.5

* A Non-Detect Multiplier of 0.5 has been applied.

This Technical Memorandum is provided as an interim output under our agreement with GEMCO. It is provided to foster discussion in relation to technical matters associated with the project and should not be relied upon in any way.

2.6 QA/QC

2.6.1 Water Quality

GHD undertook a QA/QC program to appraise the accuracy and reproducibility of the analyses (Attachment 5). The QA/QC for the assessment was performed in accordance with required guidelines, (Australian Standards (AS) 4482.1-2005; ASC NEPM (2013); ANZG, 2018).

In addition to the internal laboratory QA/QC procedures, field duplicates were collected at 10% of sites.

All RPD values for field QA/QC samples returned results less than the nominated data quality criteria (Attachment 5).

2.6.2 Sediment Quality

All RPD values for field QA/QC samples returned results (Attachment 6) less than the nominated data quality criteria with the following exceptions (Table 7):

- Nitrate (as N) were above the threshold with both at 150% RPD.
- Nitrogen (Total Oxidised) (as N) were above the threshold with both at 150% RPD.
- Chromium (III + VI) was above the threshold with 67% RPD.

Table 7 Sediment Quality QA/QC Summary for RPD exceedances

	Nutrients		Metals
Analyte	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Chromium (III+VI)
Units	mg/kg	mg/kg	mg/kg
LOR	0.1	0.1	2
Samples	<0.1	<0.1	10
Duplicate	0.7	0.7	20
RPD	150	150	67

3. Conclusions

A total of 17 transects were surveyed across the Project area over the course of three days (5th, 6th and 7th June 2024). Additionally, water samples were collected from six locations positioned around the construction footprint, with a further 10 sediment samples collected (four within the construction footprint and six adjacent to the footprint).

Marine habitat

The seabed within the footprint was confirmed to consist of open sandy substrate lacking high value habitat features (Attachment 1). Habitat is also well represented throughout the survey area. However a small pocket of rocky reef with established coral colonies was identified in the nearshore area. This was located , approximately 130 m to the north of the marine footprint.

Areas south of the footprint (Transects O and P specifically) were observed to contain diverse patches of rocky coral gardens and benthic communities. These patches are located 500-560 m south of the footprint.

Seagrass (*H. ovalis*) was observed along Transect N, approximately 310 m from the footprint, however this occurrence was limited to a few individual blades. Seagrasses were not observed during any other transects, contrasting with the observations of the summer 2023 surveys. The absence of seagrass during

this winter survey indicates that seagrasses within the survey area are seasonally absent during winter / present during summer.

Lab analyses

Particle size analysis of surface sediments within and adjacent to the footprint consisted largely of sand (0.06-2 mm; 81% average) and low levels of gravel (>2 mm; average 7%) and trace amounts of silt (2-60 µm) and clay (<2 µm).

Water and sediment samples were also assessed for a suite of analytes and was found to be free of contaminants.

Matrix interference was encountered during the laboratory metals analyses for all water samples, resulting in samples requiring lab dilution with their LORs subsequently increased by the lab (referred to as adjusted LORs); this increase was above the trace concentrations historically recorded in the MEMP. All water samples from this monitoring event returned values less than the adjusted LOR, indicating that metal concentrations are not present in highly elevated concentrations above the adjusted LORs.

High RPDs were found during QA/QC for sediment data (Nitrate, Total Oxidised N and Chromium), results for these parameters should therefore be interpreted with caution.

Sediment data was also assessed against the PASS suite of analytes with the following findings:

- No Actual Acid Sulfate Soils (AASS) were present, only PASS
- Excess Acid Neutralising Capacity (ANC) was identified such that the sediment is considered to be self-neutralising
- Overall there is a low risk of contaminant mobilisation due to acidification, aligning with the conclusions of the GEMCO Tug Replacement Project (Indo-Pacific, 2022)

Regards

Tristram Coffin
Senior Marine Scientist

Attachment 1: Tow and Drop Camera Imagery

Attachment 2: In Situ Water Quality Results

Attachment 3: Water Quality Laboratory Results

Attachment 4: Sediment Samples Laboratory Results

Attachment 5: QA/QC Water Quality Laboratory Results

Attachment 6: QA/QC Sediment Laboratory Results

Attachments

Attachment 1

Tow and Drop Camera Imagery

Transect A



Plate 1 Tow camera footage of seabed at start of transect (1m; left) and approximately 4m (middle) and 7m (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 2 Tow camera footage of seabed at approximately 11m (left), 12m (middle) and 13m (right) all showing substrate of sand with crab holes and traces of shell debris. Middle showing a boat chain across the substrate.



Plate 3 Tow camera footage of seabed at approximately 16m (left) and 19m (middle) showing substrate of sand with crab holes and traces of shell debris. Right (approximately 25m) showing the start of the coral garden.



Plate 4 Tow camera footage of seabed at approximately 28m (left), 33m (middle) and 38m (right) all showing substrate of sand with shell debris and a coral garden.

Transect B

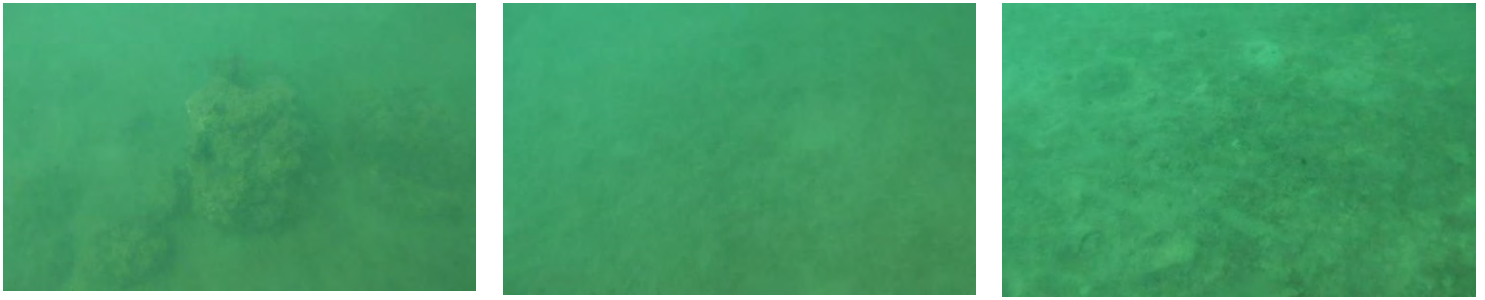


Plate 5 Tow camera footage of seabed at start of transect (1m; left) showing coral garden with sand substrate. Approximately 3m (middle) and 5m (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 6 Tow camera footage of seabed at approximately 8m (left), 11m (middle) and 14m (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 7 Tow camera footage of seabed at approximately 16m (left), 20m (middle) and 27m (right) showing substrate of sand and traces of shell debris.



Plate 8 Tow camera footage of seabed at approximately 29m (left) and 31m (middle) showing substrate of sand with shell debris. Right (approximately 35m) showing coral on sand substrate with shell debris.

Transect C

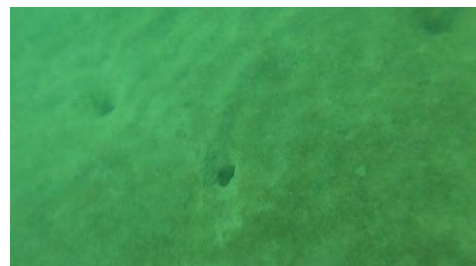


Plate 9 Tow camera footage of seabed at start of transect (1m; left) began over a coral garden. Approximately 4m (middle) and 7m (right) all showing substrate of sand with crab holes and traces of shell debris.

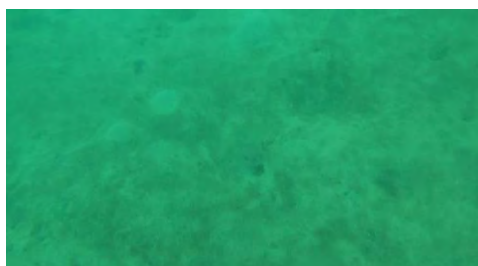


Plate 10 Tow camera footage of seabed at approximately 10m (left), 12m (middle) and 15m (right) all showing substrate of sand with crab holes and traces of shell debris. Right also with traces of macro algae.

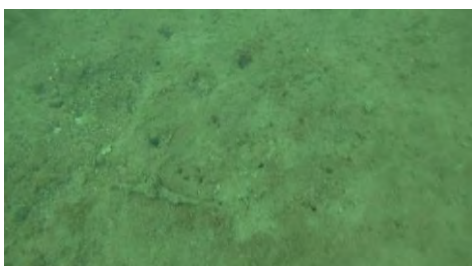


Plate 11 Tow camera footage of seabed at approximately 18m (left) and 20m (middle) showing substrate of sand with crab holes and traces of shell debris. Right (approximately 24m) showing the start of the coral garden.

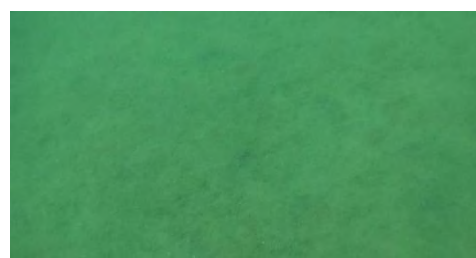
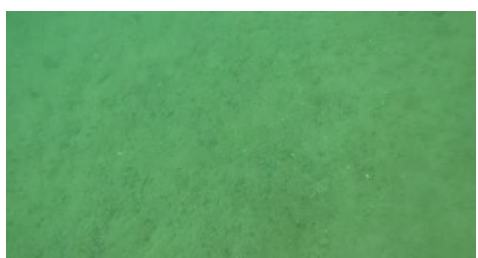


Plate 12 Tow camera footage of seabed at approximately 25m (left), 28m (middle) and 32m (right) all showing substrate of sand with shell debris and a coral garden.

Transect D



Plate 13 Tow camera footage of seabed at start of transect (1m; left) began over a coral garden. Approximately 2m (middle) and 5m (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 14 Tow camera footage of seabed at approximately 8m (left), 10m (middle) and 12m (right) all showing substrate of sand with crab holes and traces of shell debris. Right also with traces of macro algae.



Plate 15 Tow camera footage of seabed at approximately 14m (left) and 18m (middle) showing substrate of sand with crab holes and traces of shell debris. Right (approximately 20m) showing the start of the coral garden.

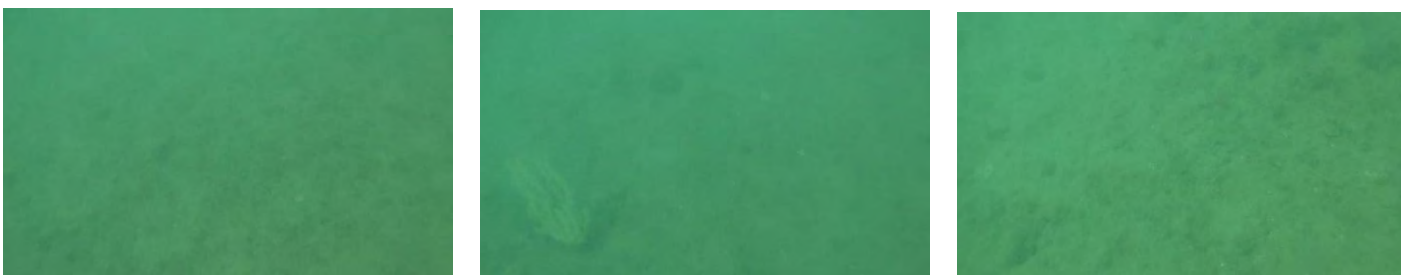


Plate 16 Tow camera footage of seabed at approximately 23m (left), 25m (middle) and 28m (right) all showing substrate of sand with shell debris and a coral garden.

Transect E



Plate 17 Tow camera footage of seabed at start of transect (left) as sandy substrate and continued on with sand and crab holes with traces of shell debris.

Transect F

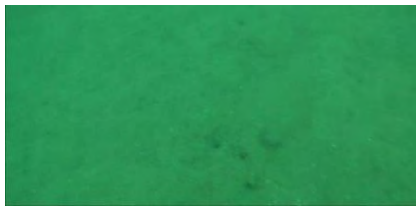
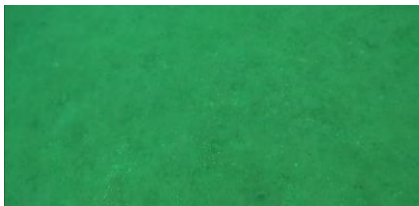


Plate 18 Tow camera footage of seabed at start of transect (left) began over sandy substrate. The middle showed substrate of sand with crab holes and traces of shell debris. Right showed a Batfish



Plate 19 Tow camera footage of seabed (left), middle shows small coral substrate and right shows coral garden

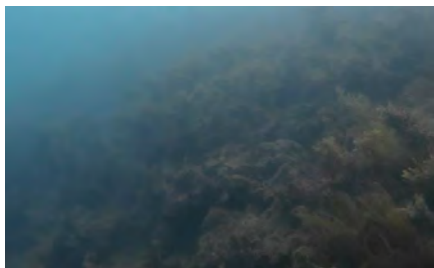


Plate 20 Tow camera footage of seabed (left) showing macroalgae beds

Transect G



Plate 21 Tow camera footage of seabed at approximately 17m (left), 33m (middle) and 41m (right) all showing substrate of sand with crab holes and shell debris.

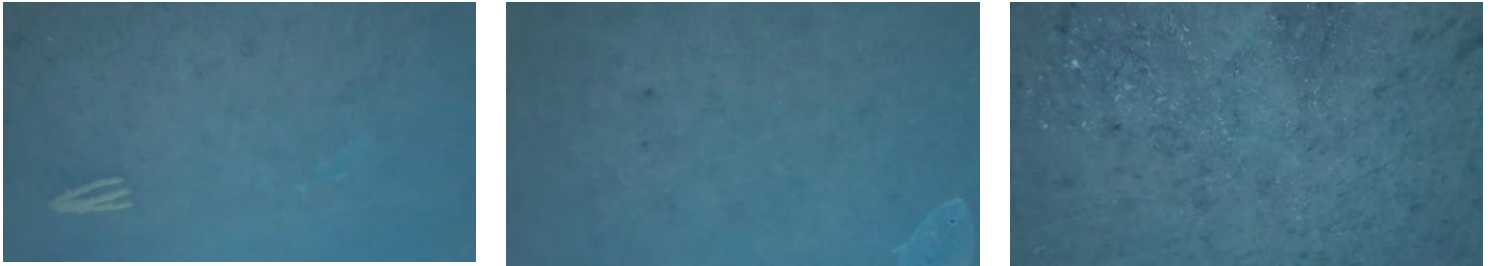


Plate 22 Tow camera footage of seabed at approximately 45m (left), 49m (middle) and 53m (right) all showing substrate of sand with shell debris and traces of crab holes. Left also with yellow sponge and golden trevally. Middle with golden trevally.



Plate 23 Tow camera footage of seabed at approximately 57m (left) and 65m (right) showing substrate of sand with shell debris and macroalgae and coral spp.

Transect H

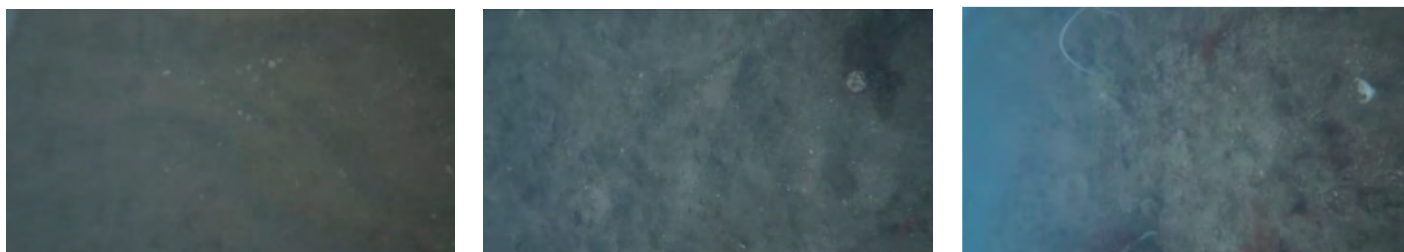


Plate 24 Tow camera footage of seabed at approximately 1m (left), 6m (middle) and 12m (right) all showing substrate of sand with shell debris. Right also showed polychaete tubes and traces of macro algae.

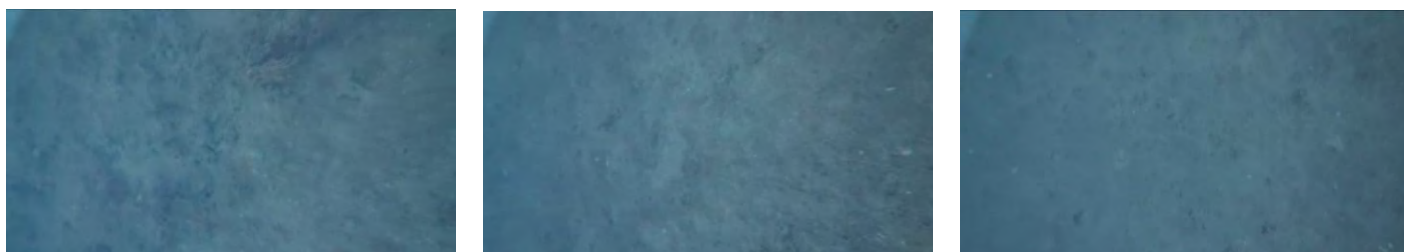


Plate 25 Tow camera footage of seabed at approximately 18m (left), 22m (middle) and 28m (right) all showing substrate of sand with crab holes and shell debris. Left also showed coral rubble.



Plate 26 Tow camera footage of seabed at approximately 33m (left), 40m (middle) and 46m (right) all showing substrate of sand with crab holes and shell debris. Middle also showed material debris.

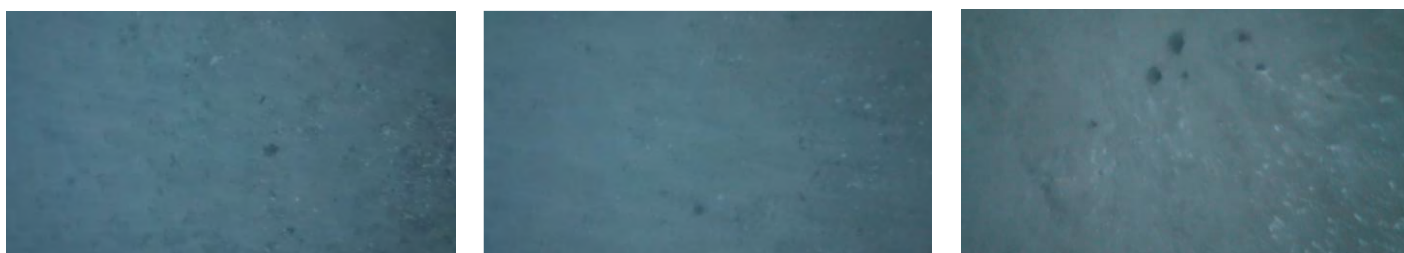


Plate 27 Tow camera footage of seabed at approximately 50m (left), 68m (middle) and 80m (right) all showing substrate of sand with shell debris and a coral garden.

Transect I



Plate 28 Tow camera footage of seabed at start of transect (22m; left) began over sandy substrate. Approximately 43m (middle) over rocky outcrops and small patches of coral and 86.4m (right) showing rocky outcrop..

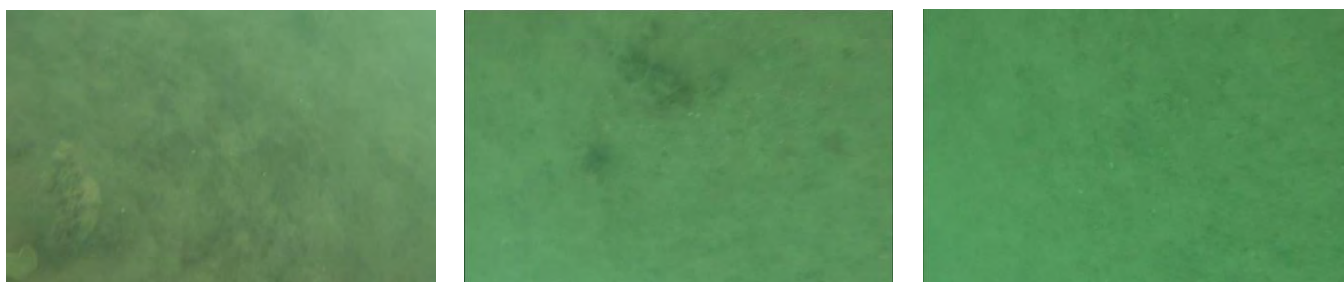


Plate 29 Tow camera footage of seabed at approximately 173m (left), 216m (middle) and 259m (right) all showing substrate of sand with crab holes and traces of shell debris. Left also with traces of macro algae.



Plate 30 Tow camera footage of seabed at approximately 259m (left) and 243m (middle) showing pieces of debris on sandy substrate. Right (approximately 329.76m) showing sandy substrate

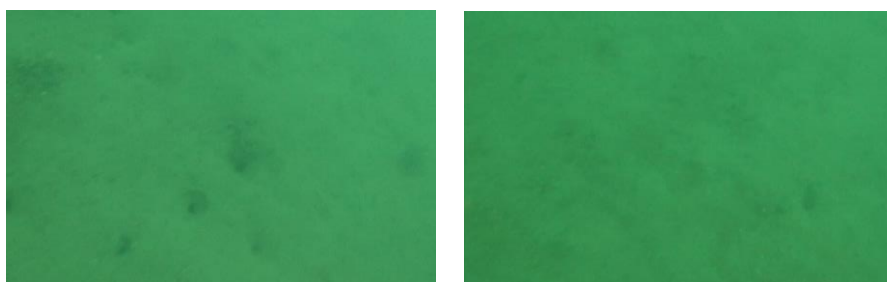


Plate 31 Tow camera footage of seabed at approximately 345m (left), 443m (middle) all showing substrate of sand with shell debris.

Transect J

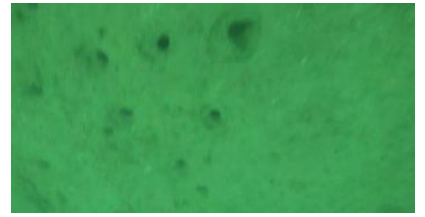
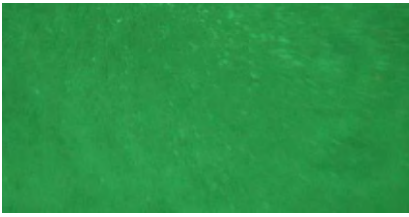


Plate 32 Tow camera footage of seabed at start of transect (left) over sandy substrate with shell debris. Approximately (middle) and (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 33 Tow camera footage of seabed at approximately (left), (middle) (right) all showing substrate of sand with crab holes and traces of shell debris. Left also with traces of macro algae.

Transect K

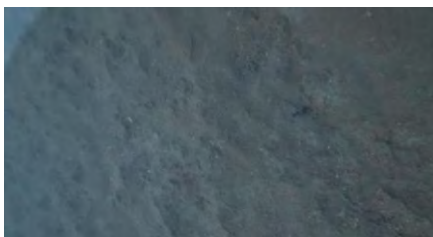


Plate 34 Tow camera footage of seabed at start of transect (left) began over a shell debris on sand. This continued for (middle) and then right showed sandy substrate with macroalgae.

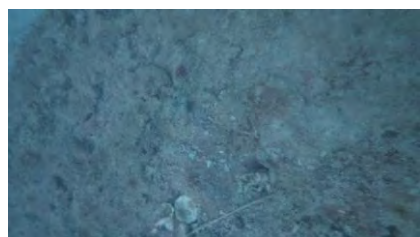
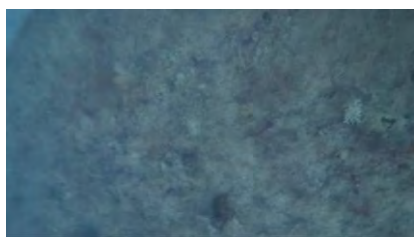


Plate 35 Tow camera footage of seabed at approximately (left), (middle) (right) all showing substrate of sand with crab holes and traces of shell debris. Some rock can also be observed throughout.

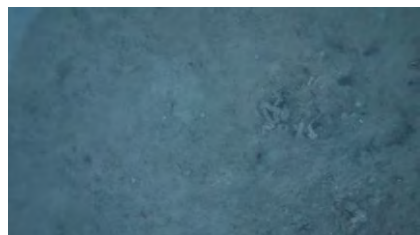


Plate 36 Tow camera footage of seabed at approximately (left) and (middle) showing substrate of sand with crab holes and traces of shell debris. Macroalgae is seen throughout all three.

Transect L



Plate 37 Tow camera footage of seabed at start of transect (left). Both the middle and right all showed substrate of sand with crab holes and traces of shell debris.



Plate 38 Tow camera footage of seabed (left), (middle), (right) all showing substrate of sand with crab holes and traces of shell debris.

Transect M

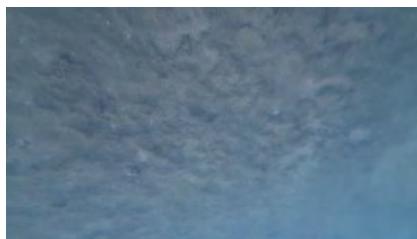


Plate 39 Tow camera footage of seabed at start of transect (1m; left) began over a coral garden. Approximately 52m (middle) and 169m (right) all showing substrate of sand with crab holes and traces of shell debris.



Plate 40 Tow camera footage of seabed at approximately 231m (left), 298m (middle) and 304m (right) all showing substrate of sand with crab holes and traces of shell debris. Right also with traces of macro algae.



Plate 41 Tow camera footage of seabed at approximately 338m (left) and 396m (middle) showing substrate of sand with crab holes and traces of shell debris. Right (approximately 398m) showing a larger hole possibly used by larger fauna as protection.



Plate 42 Tow camera footage of seabed at approximately 453m (left) showing holes.

Transect N

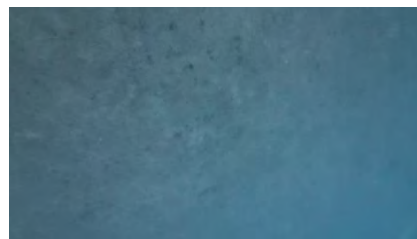


Plate 43 Tow camera footage of seabed at start of transect (1m; left) began over a coral garden. Approximately 4m (middle) and 7m (right) all showing substrate of sand with crab holes and traces of shell debris.

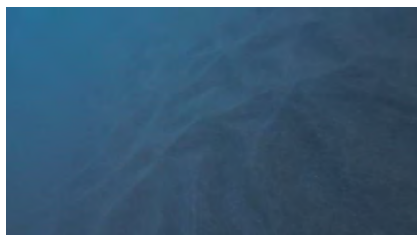


Plate 44 Tow camera footage of seabed at approximately (left), (middle), (right) all showing substrate of sand with crab holes and traces of shell debris. Right also with traces of macro algae.



*Plate 45 Tow camera footage of seabed showing *H. ovalis* of sand. Left showing some *halophila ovalis* (images taken from same patch at various frames and angles) in sparse patches.*

Transect O



Plate 46 Tow camera footage of seabed at start of transect (left) sandy substrate in which it slowly transitioned into harder and rockier substrate. Following this, the habitat shifted into a mix of sandy and rocky substrate (Right) with some small individual corals being observed (middle).

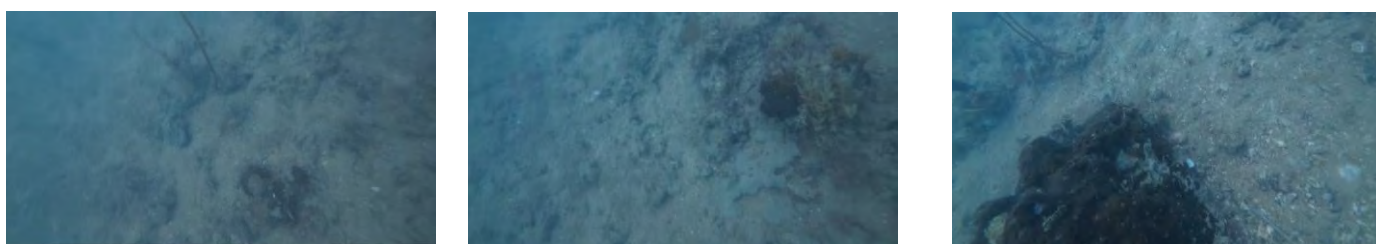


Plate 47 Tow camera footage of seabed (left), (middle) (right). The section began as sandy and rocky substrate providing habitat for a range of coral as well as sponges. Macroalgae was observed throughout all.



Plate 48 Tow camera footage of seabed (left), (middle) (right) all showing substrate of sand with both hard and soft coral individuals and groups.

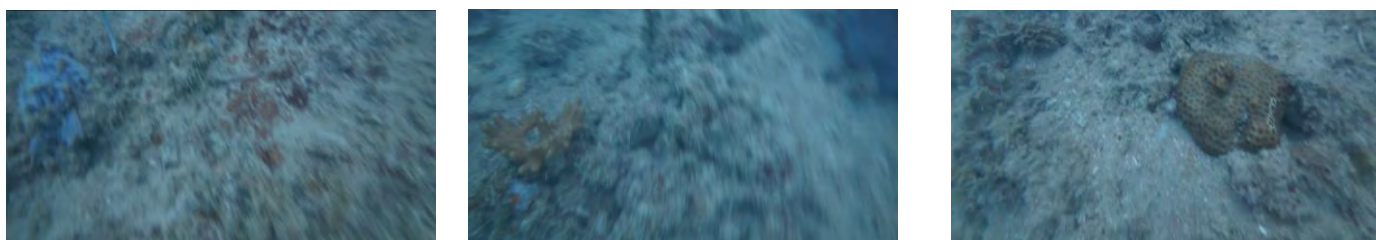


Plate 49 Tow camera footage of seabed (left), (middle) (right) all showing substrate of sand with coral individuals.

Transect P

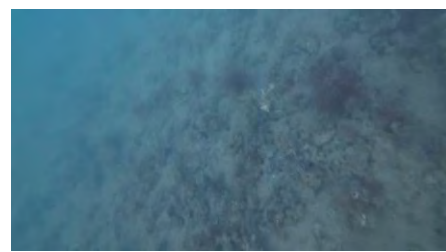


Plate 50 Tow camera footage of seabed at start of transect and ended as sandy substrate.



Plate 51 Tow camera footage of seabed (left), (middle) and (right) all showing substrate of sand high amounts of macroalgae and coral gardens. Right also with traces of macro algae.



*Plate 52 Tow camera footage of seabed (left) and 20m (middle) showing substrate of sand with crab holes and traces of shell debris. Middle showing a large individual of *Platygyra* spp.*

Transect Q



Plate 53 Tow camera footage of seabed at start of transect and ended as sandy substrate with shell and crab holes.



Plate 54 Tow camera footage of seabed at start of transect and ended as sandy substrate with shell and crab holes. Right image shows coral growth.

Attachment 2

In Situ Water Quality Results

Table 8 *In situ water quality data for sites I1 – 5*

Site	I1	I2	I3	I4	I5
Time	0710	0730	0740	0755	0800
Temperature (°C)	25.0	24.9	24.8	23.7	23.6
Pressure (mmHg)	761.7	761.9	762.0	762.0	762.0
DO (%)	101.1	102.0	100.8	101.6	99.8
DO (mg/L)	7.17	7.25	7.17	7.39	7.27
Conductivity (SPC)	41,833	41,880	41947	41307	41288
pH	7.85	8.07	8.06	8.11	8.09
Turbidity (NTU)	2.60	2.33	1.93	2.81	2.84
Depth (m)	0.398	0.404	0.439	0.580	0.585

Table 9 *In situ water quality data for sites C1 – 6*

Site	C1	C2	C3	C4	C5	C6
Time	0815	0825	0840	0900	0910	0920
Temperature (°C)	23.8	24.9	24.5	25.0	25.0	25.0
Pressure (mmHg)	762.0	762.2	762.2	762.0	762.0	762.1
DO (%)	100.9	98.7	99.3	98.1	100.2	99.5
DO (mg/L)	7.33	7.01	7.11	6.95	7.11	7.06
Conductivity (SPC)	41381	41916	41738	41902	41851	41844
pH	8.11	8.09	8.10	8.10	8.11	8.10
Turbidity (NTU)	3.37	2.12	2.00	2.50	2.64	2.60
Depth (m)	0.451	0.415	0.461	1.420	1.473	0.485

Attachment 3

Water Quality Laboratory Results



CERTIFICATE OF ANALYSIS

Work Order : **EB2419917**
Client : **GHD PTY LTD**
Contact : **MS BRIONI ARMSTRONG**
Address : **P O BOX 930**
TOWNSVILLE QLD, AUSTRALIA 4810
Telephone : **+61 07 4771 5645**
Project : **12624084 GEMCO WQ Disposal**
Order number : **----**
C-O-C number : **----**
Sampler : **Craig Chargulaf, Emma Raudonikis**
Site : **GROOTE EYLANDT, MILNER BAY**
Quote number : **EB24GHDSE0025**
No. of samples received : **11**
No. of samples analysed : **11**

Page : 1 of 21
Laboratory : Environmental Division Brisbane
Contact : Nathan King
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 11-Jun-2024 17:53
Date Analysis Commenced : 12-Jun-2024
Issue Date : 18-Jun-2024 15:32



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Morgan Lennox	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- EK067G (Total Phosphorous as P): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EK061G (Total Kjeldahl Nitrogen as N): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders (EB2419917, EB2417718) to allow for soil analysis. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- EG020-T (Total Metals by ICP-MS) /EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for some samples due to matrix interference.



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	<0.025	<0.025	<0.025	<0.025	<0.025
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	<0.026	<0.026	<0.026	<0.026	<0.026
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.10	0.10	0.10	0.08	0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	5.21	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	5.21	<0.01	<0.01	<0.01	<0.01



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005
				Result	Result	Result	Result	Result
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	5.2	<0.5	<0.5	<0.5	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP066: Polychlorinated Biphenyls (PCB)								
^ Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55	
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005	
				Result	Result	Result	Result	Result	
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
4,4`-DDT	50-29-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Methoxychlor	72-43-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/5 0-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Parathion	56-38-2	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time					09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005	
				Result	Result	Result	Result	Result	
EP068B: Organophosphorus Pesticides (OP) - Continued									
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4,6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4,5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55	
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005	
				Result	Result	Result	Result	Result	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20	
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50	
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50	
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20	
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100	
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1	
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419917-001	EB2419917-002	EB2419917-003	EB2419917-004	EB2419917-005
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	72.4	75.4	80.6	70.1	83.0
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	82.2	90.5	96.4	78.0	102
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	78.5	87.8	93.8	75.2	96.3
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	31.7	33.0	36.7	30.3	38.9
2-Chlorophenol-D4	93951-73-6	1.0	%	67.2	69.3	78.4	63.6	80.1
2,4,6-Tribromophenol	118-79-6	1.0	%	70.1	75.6	80.6	67.3	85.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	65.2	68.5	76.0	61.9	81.4
Anthracene-d10	1719-06-8	1.0	%	88.0	93.2	100	83.3	110
4-Terphenyl-d14	1718-51-0	1.0	%	85.6	87.7	96.4	77.8	106
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	109	113	112	109	113
Toluene-D8	2037-26-5	2	%	94.8	98.4	95.1	96.5	96.1
4-Bromofluorobenzene	460-00-4	2	%	108	111	110	109	107



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	<0.025	<0.025	<0.025	<0.025	<0.025
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	<0.026	<0.026	<0.026	<0.026	<0.026
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.09	0.16	0.10	0.09	0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010
				Result	Result	Result	Result	Result
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	0.07
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP066: Polychlorinated Biphenyls (PCB)								
^ Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time					09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010	
				Result	Result	Result	Result	Result	
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
4,4`-DDT	50-29-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Methoxychlor	72-43-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/5 0-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Parathion	56-38-2	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time					09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010	
				Result	Result	Result	Result	Result	
EP068B: Organophosphorus Pesticides (OP) - Continued									
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4,6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4,5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10	
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010	
				Result	Result	Result	Result	Result	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20	
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50	
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50	
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20	
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100	
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100	
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1	
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2	



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419917-006	EB2419917-007	EB2419917-008	EB2419917-009	EB2419917-010
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	73.7	76.4	81.9	75.5	69.1
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	77.9	81.8	90.6	90.4	80.7
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	77.0	82.6	90.6	86.9	79.0
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	29.0	30.9	33.5	29.9	30.8
2-Chlorophenol-D4	93951-73-6	1.0	%	60.5	64.0	71.0	65.7	63.0
2,4,6-Tribromophenol	118-79-6	1.0	%	69.1	72.0	77.6	68.7	67.6
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	61.3	66.2	71.7	68.4	64.4
Anthracene-d10	1719-06-8	1.0	%	84.1	88.6	94.2	91.0	87.2
4-Terphenyl-d14	1718-51-0	1.0	%	77.4	80.9	88.8	84.3	77.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	110	111	112	112	112
Toluene-D8	2037-26-5	2	%	96.1	97.0	99.3	94.5	95.1
4-Bromofluorobenzene	460-00-4	2	%	108	110	110	108	109



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C6	----	----	----	----
				0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419917-011	-----	-----	-----	-----
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.005	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.005	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.005	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.025	----	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.005	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.005	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.005	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.026	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.08	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	----	----	----	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	C6 0.3	----	----	----	----
Sampling date / time					09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2419917-011	-----	-----	-----	-----
				Result	----	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.5	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.05	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
^ Total Polychlorinated biphenyls	----	1	µg/L		<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4,4'-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4,4'-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419917-011	-----	-----	-----	-----
Result				----	----	----	----	----

EP068A: Organochlorine Pesticides (OC) - Continued

Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	----	----	----	----
4,4'-DDT	50-29-3	2.0	µg/L	<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L	<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/5 0-2	0.5	µg/L	<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	----	----	----	----

EP068B: Organophosphorus Pesticides (OP)

Dichlorvos	62-73-7	0.5	µg/L	<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	----	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419917-011	-----	-----	-----	-----
Result				----	----	----	----	----
EP068B: Organophosphorus Pesticides (OP) - Continued								
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2,4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2,4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2,6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----
2,4,6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2,4,5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419917-011	-----	-----	-----	-----
Result				----	----	----	----	----

EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued

Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----

EP080/071: Total Petroleum Hydrocarbons

C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	----	----	----	----

EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions

C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	----	----	----	----

EP080: BTEXN

Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				C6	----	----	----	----
				0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419917-011	-----	-----	-----	-----
				Result	----	----	----	----
EP080: BTEXN - Continued								
^ Total Xylenes	----	2	µg/L	<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	69.4	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	79.8	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	77.6	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	28.1	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	59.4	----	----	----	----
2,4,6-Tribromophenol	118-79-6	1.0	%	47.3	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	63.5	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	84.2	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	71.9	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	113	----	----	----	----
Toluene-D8	2037-26-5	2	%	95.9	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	107	----	----	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	37	138
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	45	139
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	45	139
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2,4,6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

Attachment 4

Sediment Sample Laboratory Results



CERTIFICATE OF ANALYSIS

Work Order : **EB2419918**
Client : **GHD PTY LTD**
Contact : **MS BRIONI ARMSTRONG**
Address : **P O BOX 930**
TOWNSVILLE QLD, AUSTRALIA 4810
Telephone : **+61 07 4771 5645**
Project : **12624084 GEMCO WQ Disposal**
Order number : **----**
C-O-C number : **----**
Sampler : **Craig Chargulaf, Emma Raudonikis**
Site : **----**
Quote number : **EB24GHDSE0025**
No. of samples received : **11**
No. of samples analysed : **11**

Page : 1 of 26
Laboratory : Environmental Division Brisbane
Contact : Nathan King
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 11-Jun-2024 17:53
Date Analysis Commenced : 14-Jun-2024
Issue Date : 26-Jun-2024 16:28



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Morgan Lennox	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK061G (Total Kjeldahl Nitrogen) and EK067G (Total Phosphorus): Sample EB2419331-011 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders EB2419917 & EB2419918 to allow for soil analysis. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- ASS: EA033 (CRS Suite): Analysis is performed as per the Acid Sulfate Soils Laboratory Methods Guidelines (2004) and the updated National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT (2018)
- EK061G (Total Kjeldahl Nitrogen): Sample C2 0.3 (EB2419918-007) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ASS: EA033 (CRS Suite): Retained Acidity not required because pH KCl greater than or equal to 4.5
- EK067G (Total Phosphorus): Sample C3 0.3 (EB2419918-008) shows poor matrix spike recovery due to sample heterogeneity. Confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): C3 0.3 (EB2419918-008) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): The limit of reporting has been raised for some samples due to matrix interference.
- ASS: EA033 (CRS Suite): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m³ in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m³'.
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.4	9.4	9.4	9.5	----
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	----
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.012	0.010	0.017	0.021	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	10	13	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	22.1	20.5	13.4	20.6	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	4410	4100	2680	4120	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	7.07	6.58	4.29	6.60	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	10	13	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	----
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	8.6	8.4	8.6	8.4	----
ø pH (Fox)	----	0.1	pH Unit	9.4	9.9	9.8	6.6	----
ø Reaction Rate	----	1	-	4	2	2	2	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	32.4	20.6	23.4	19.6	22.4
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	----	93



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EA150: Particle Sizing - Continued								
+150µm	----	1	%	----	----	----	----	80
+300µm	----	1	%	----	----	----	----	78
+425µm	----	1	%	----	----	----	----	72
+600µm	----	1	%	----	----	----	----	61
+1180µm	----	1	%	----	----	----	----	30
+2.36mm	----	1	%	----	----	----	----	7
+4.75mm	----	1	%	----	----	----	----	2
+9.5mm	----	1	%	----	----	----	----	<1
+19.0mm	----	1	%	----	----	----	----	<1
+37.5mm	----	1	%	----	----	----	----	<1
+75.0mm	----	1	%	----	----	----	----	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	----	5
Silt (2-60 µm)	----	1	%	----	----	----	----	2
Sand (0.06-2.00 mm)	----	1	%	----	----	----	----	79
Gravel (>2mm)	----	1	%	----	----	----	----	14
Cobbles (>6cm)	----	1	%	----	----	----	----	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	6	6	7	13	10
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	11	20	16	10	20
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg	3	<2	<2	<3	<2
Zinc	7440-66-6	5	mg/kg	9	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	0.7
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	0.7
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	370	190	130	120	180
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	370	190	130	120	180
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	241	108	108	111	174
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.2	0.2	0.2	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued								
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	<2	<2	<2
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	-----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	-----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	-----	0.5	mg/kg	0.6	0.6	0.6	0.6	0.6
^ Benzo(a)pyrene TEQ (LOR)	-----	0.5	mg/kg	1.2	1.2	1.2	1.2	1.2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	-----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	-----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	-----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	-----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	-----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	-----	50	mg/kg	<50	<50	<50	<50	<50



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time				09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit	EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
[^] >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
[^] >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
[^] Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
[^] Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	113	102	107	98.0	104
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	87.0	82.3	88.1	78.5	84.2
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	65.1	62.2	74.6	62.5	65.4
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	95.2	83.3	92.1	86.0	91.2
2-Chlorophenol-D4	93951-73-6	0.5	%	94.1	80.2	87.7	82.7	83.3
2,4,6-Tribromophenol	118-79-6	0.5	%	76.8	68.3	77.1	69.0	85.8
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	101	90.6	95.4	89.5	96.1
Anthracene-d10	1719-06-8	0.5	%	83.5	80.0	84.2	77.4	84.7
4-Terphenyl-d14	1718-51-0	0.5	%	107	99.8	103	95.0	103



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	I1 0.3	I2 0.3	I3 0.3	I4 0.3	I5 0.3
Sampling date / time					09-Jun-2024 07:00	09-Jun-2024 07:25	09-Jun-2024 07:40	09-Jun-2024 07:50	09-Jun-2024 07:55
Compound	CAS Number	LOR	Unit		EB2419918-001	EB2419918-002	EB2419918-003	EB2419918-004	EB2419918-005
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%		89.6	89.7	90.0	95.0	82.8
Toluene-D8	2037-26-5	0.2	%		86.3	86.7	88.9	89.8	81.4
4-Bromofluorobenzene	460-00-4	0.2	%		86.2	89.0	89.8	92.9	80.7



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	----	9.6	----	----
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	----	----	<2	----	----
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	----	<0.02	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	----	0.016	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	----	10	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	24.2	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	4830	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	7.75	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	1.5	----	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	<0.02	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	<10	----	----
Liming Rate	----	1	kg CaCO3/t	----	----	<1	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	<0.02	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	10	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	<1	----	----
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	----	----	8.5	----	----
ø pH (Fox)	----	0.1	pH Unit	----	----	9.8	----	----
ø Reaction Rate	----	1	-	----	----	2	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	23.0	31.2	22.0	28.3	28.6
EA150: Particle Sizing								
+75µm	----	1	%	98	85	----	91	84



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EA150: Particle Sizing - Continued								
+150µm	----	1	%	82	68	----	89	76
+300µm	----	1	%	28	64	----	74	72
+425µm	----	1	%	13	50	----	59	54
+600µm	----	1	%	6	38	----	44	33
+1180µm	----	1	%	3	19	----	25	12
+2.36mm	----	1	%	1	10	----	13	5
+4.75mm	----	1	%	<1	4	----	5	1
+9.5mm	----	1	%	<1	<1	----	<1	<1
+19.0mm	----	1	%	<1	<1	----	<1	<1
+37.5mm	----	1	%	<1	<1	----	<1	<1
+75.0mm	----	1	%	<1	<1	----	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	2	12	----	8	11
Silt (2-60 µm)	----	1	%	<1	3	----	1	5
Sand (0.06-2.00 mm)	----	1	%	96	72	----	74	77
Gravel (>2mm)	----	1	%	2	13	----	17	7
Cobbles (>6cm)	----	1	%	<1	<1	----	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	14	8	6	6	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	6	16	22	9	17
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	8	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time					09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit		EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
					Result	Result	Result	Result	Result
EK055-P: Ammonia as N									
Ammonia as N	7664-41-7	20	mg/kg		<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		2.7	4.2	1.0	1.6	1.4
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		2.7	4.2	1.0	1.6	1.4
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		70	460	80	<20	140
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		70	460	80	<20	140
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		135	192	107	62	91
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg		<0.1	0.4	<0.1	<0.1	0.2
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
[^] Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
[^] Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
[^] Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued								
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	<2	<2	<2
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	-----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	-----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	-----	0.5	mg/kg	0.6	0.6	0.6	0.6	0.6
^ Benzo(a)pyrene TEQ (LOR)	-----	0.5	mg/kg	1.2	1.2	1.2	1.2	1.2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	-----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	-----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	-----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	-----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	-----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	-----	50	mg/kg	<50	<50	<50	<50	<50



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time				09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit	EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
[^] >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
[^] >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
[^] Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
[^] Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	93.3	101	96.4	91.5	87.2
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	75.1	83.4	78.6	72.6	73.2
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	54.8	67.8	58.9	50.9	49.3
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	84.4	89.5	84.6	84.6	84.7
2-Chlorophenol-D4	93951-73-6	0.5	%	78.3	81.2	79.0	78.6	80.2
2,4,6-Tribromophenol	118-79-6	0.5	%	74.9	78.6	74.3	71.6	70.9
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	86.3	93.8	88.9	87.0	79.4
Anthracene-d10	1719-06-8	0.5	%	77.3	82.7	77.9	76.3	75.6
4-Terphenyl-d14	1718-51-0	0.5	%	92.7	104	97.5	93.4	92.5



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	C1 0.3	C2 0.3	C3 0.3	C4 0.3	C5 0.3
Sampling date / time					09-Jun-2024 08:10	09-Jun-2024 08:25	09-Jun-2024 08:40	09-Jun-2024 09:00	09-Jun-2024 09:10
Compound	CAS Number	LOR	Unit		EB2419918-006	EB2419918-007	EB2419918-008	EB2419918-009	EB2419918-010
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		88.0	89.9	90.6	89.8	91.2
Toluene-D8	2037-26-5	0.2	%		84.8	87.8	87.9	87.1	87.1
4-Bromofluorobenzene	460-00-4	0.2	%		87.0	87.6	88.9	91.0	86.2



Analytical Results

Sub-Matrix: **SEDIMENT**
 (Matrix: **SOIL**)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419918-011	-----	-----	-----	-----
				Result	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	36.1	----	----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	87	----	----	----	----
+150µm	----	1	%	83	----	----	----	----
+300µm	----	1	%	70	----	----	----	----
+425µm	----	1	%	49	----	----	----	----
+600µm	----	1	%	23	----	----	----	----
+1180µm	----	1	%	6	----	----	----	----
+2.36mm	----	1	%	2	----	----	----	----
+4.75mm	----	1	%	<1	----	----	----	----
+9.5mm	----	1	%	<1	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	8	----	----	----	----
Silt (2-60 µm)	----	1	%	3	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	86	----	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	6	----	----	----	----
Copper	7440-50-8	5	mg/kg	<5	----	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	----	----	----	----



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	C6 0.3	----	----	----	----
Sampling date / time					09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2419918-011	-----	-----	-----	-----
					Result	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----
EK055-P: Ammonia as N									
Ammonia as N	7664-41-7	20	mg/kg		<20	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		1.3	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		1.3	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		240	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		240	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		130	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg		0.3	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	0.1	mg/kg		<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg		<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg		<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg		<0.05	----	----	----	----



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419918-011	-----	-----	-----	-----
Result				Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	-----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----
4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	----	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	----	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	----	----	----	----
Dimethoate	60-51-5	0.05	mg/kg	<0.05	----	----	----	----
Diazinon	333-41-5	0.05	mg/kg	<0.05	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	----	----	----	----

Sub-Matrix: SEDIMENT
(Matrix: SOIL)

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C6 0.3	----	----	----	----
Sampling date / time			09-Jun-2024 09:20	----	----	----	----	
Compound	CAS Number	LOR	Unit	EB2419918-011	-----	-----	-----	-----
				Result	-----	-----	-----	-----
EP068B: Organophosphorus Pesticides (OP) - Continued								
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	----	----	----	----
Malathion	121-75-5	0.05	mg/kg	<0.05	----	----	----	----
Fenthion	55-38-9	0.05	mg/kg	<0.05	----	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	----	----	----	----
Parathion	56-38-2	0.2	mg/kg	<0.2	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	----	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	----	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	----	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	----	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	----	----	----	----
Ethion	563-12-2	0.05	mg/kg	<0.05	----	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	----	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								



Analytical Results

Sub-Matrix: SEDIMENT
 (Matrix: SOIL)

Sample ID

				C6 0.3	----	----	----	----
Sampling date / time				09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419918-011	-----	-----	-----	-----
Result				----	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	----
^ Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	100	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	80.1	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	53.1	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	88.8	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	84.2	----	----	----	----
2,4,6-Tribromophenol	118-79-6	0.5	%	74.6	----	----	----	----



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	C6 0.3	----	----	----	----
				Sampling date / time	09-Jun-2024 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2419918-011	-----	-----	-----	-----	-----
				Result	----	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%	88.1	----	----	----	----	----
Anthracene-d10	1719-06-8	0.5	%	82.2	----	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	103	----	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	86.5	----	----	----	----	----
Toluene-D8	2037-26-5	0.2	%	87.8	----	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	90.2	----	----	----	----	----



Surrogate Control Limits

Sub-Matrix: SEDIMENT		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	16	134
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	10	138
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	23	134
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	35	154
2-Chlorophenol-D4	93951-73-6	42	153
2,4,6-Tribromophenol	118-79-6	26	157
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	34	156
Anthracene-d10	1719-06-8	37	153
4-Terphenyl-d14	1718-51-0	42	172
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	53	134
Toluene-D8	2037-26-5	60	131
4-Bromofluorobenzene	460-00-4	59	127

Certificate of Analysis

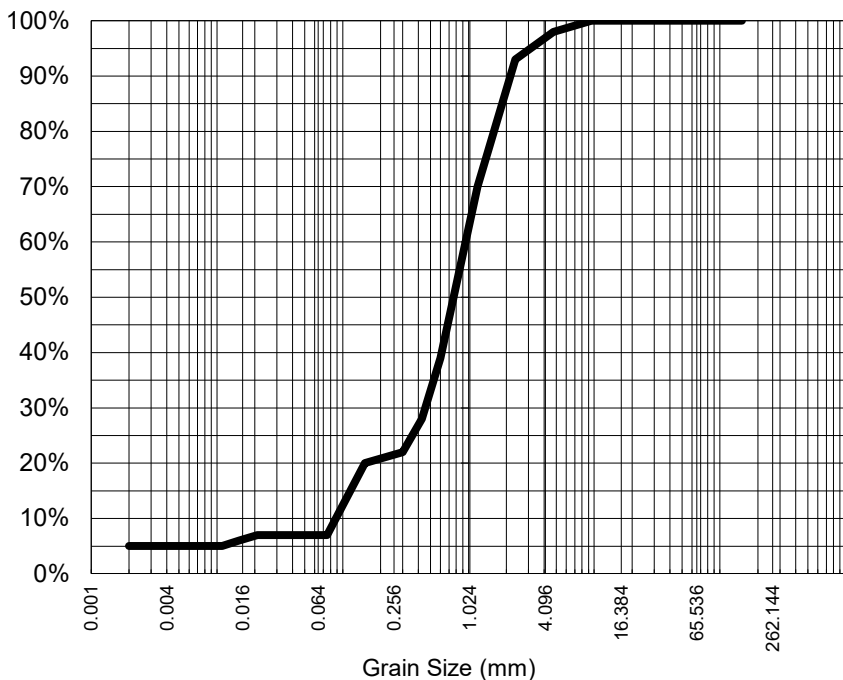
ALS Laboratory Group Pty Ltd
2 Byth Street
Stafford, QLD 4053
pH 07 3243 7222
samples.brisbane@alsenviro.com

ALS Environmental
Brisbane QLD



CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-005 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** I5 0.3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	93%
1.18	70%
0.600	39%
0.425	28%
0.300	22%
0.150	20%
0.075	7%
Particle Size (microns)	
58	7%
41	7%
29	7%
21	7%
15	6%
11	5%
7	5%
5	5%
2	5%

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Loss on Pretreatment NA

Sample Description:

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

Analysed: 17-Jun-24

Limit of Reporting: 1%

Dispersion Method Shaker

Satish Trivedi
Soil Senior Chemist
Authorised Signatory

NATA Accreditation: 825 Site: Brisbane
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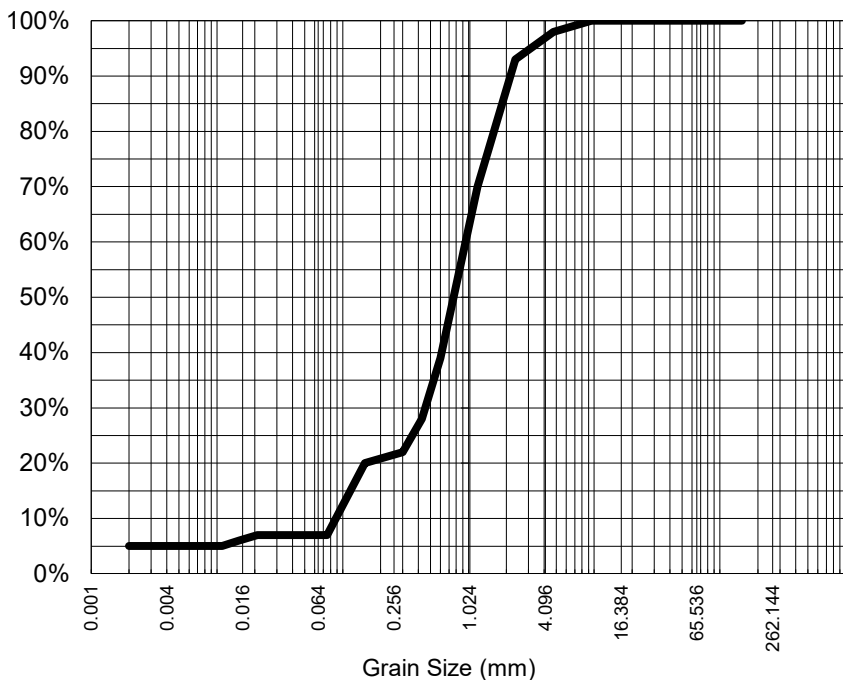
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pH 07 3243 7222
samples.brisbane@alsenviro.com

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CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-005DUP / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** I5 0.3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	93%
1.18	70%
0.600	39%
0.425	28%
0.300	22%
0.150	20%
0.075	7%
Particle Size (microns)	
58	7%
41	7%
29	7%
21	7%
15	6%
11	5%
7	5%
5	5%
2	5%

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Loss on Pretreatment NA

Sample Description:

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

Analysed: 17-Jun-24

Limit of Reporting: 1%

Dispersion Method Shaker

Satish Trivedi
Soil Senior Chemist
Authorised Signatory

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Certificate of Analysis

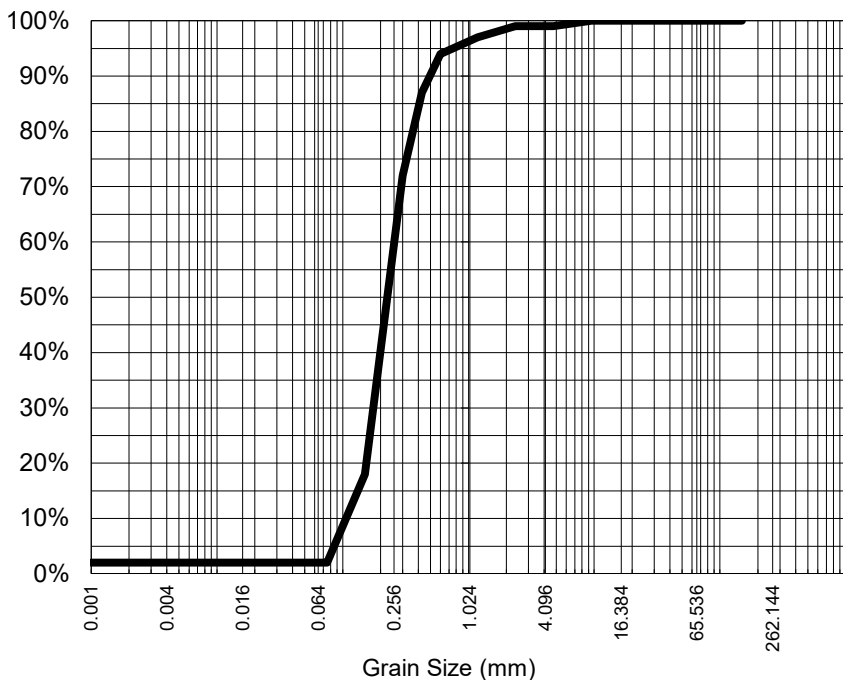
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samples.brisbane@alsenviro.com

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Brisbane QLD



CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-006 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** C1 0.3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	99%
1.18	97%
0.600	94%
0.425	87%
0.300	72%
0.150	18%
0.075	2%
Particle Size (microns)	
56	2%
40	2%
28	2%
20	2%
15	2%
10	2%
7	2%
5	2%
1	2%

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Loss on Pretreatment NA

Sample Description:

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.76

Analysed: 17-Jun-24

Limit of Reporting: 1%

Dispersion Method Shaker

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Soil Senior Chemist
Authorised Signatory

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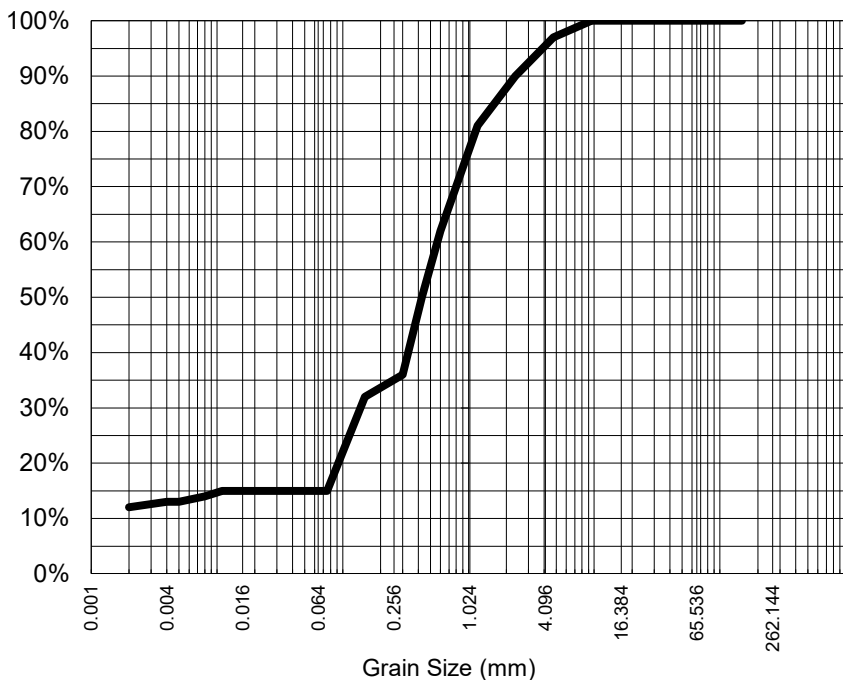
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CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-007 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** C2 0.3

Particle Size Distribution



Analysis Notes

Samples analysed as received.

Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	90%
1.18	81%
0.600	62%
0.425	50%
0.300	36%
0.150	32%
0.075	15%
Particle Size (microns)	
60	15%
42	15%
30	15%
21	15%
15	15%
11	15%
8	14%
5	13%
2	12%

Median Particle Size (mm)*	0.425

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 17-Jun-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.56

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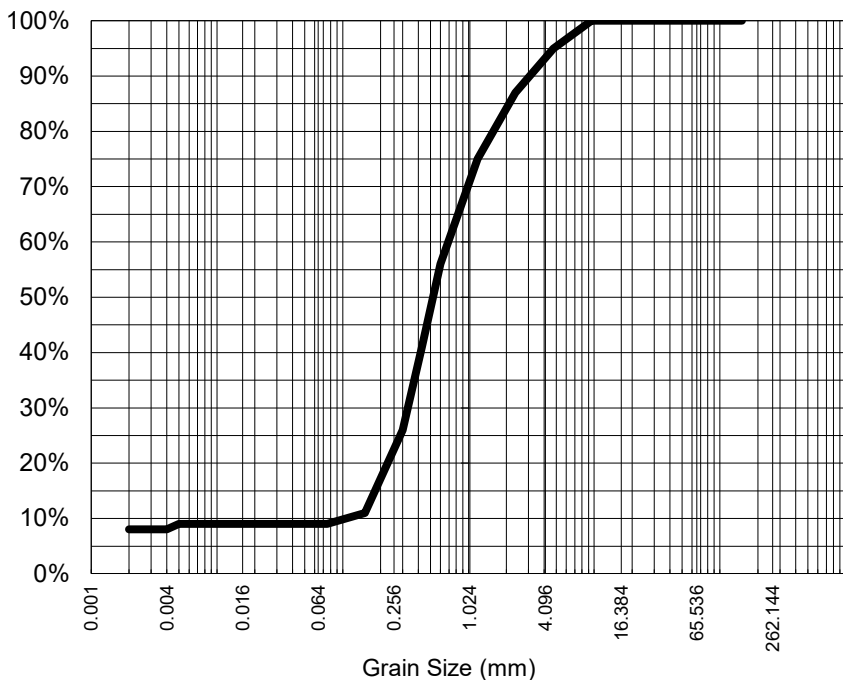
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CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-009 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** C4 0.3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	87%
1.18	75%
0.600	56%
0.425	41%
0.300	26%
0.150	11%
0.075	9%
Particle Size (microns)	
60	9%
42	9%
30	9%
21	9%
15	9%
11	9%
8	9%
5	9%
2	8%

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Loss on Pretreatment NA

Sample Description:

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.59

Analysed: 17-Jun-24

Limit of Reporting: 1%

Dispersion Method Shaker

Satish Trivedi
Soil Senior Chemist
Authorised Signatory

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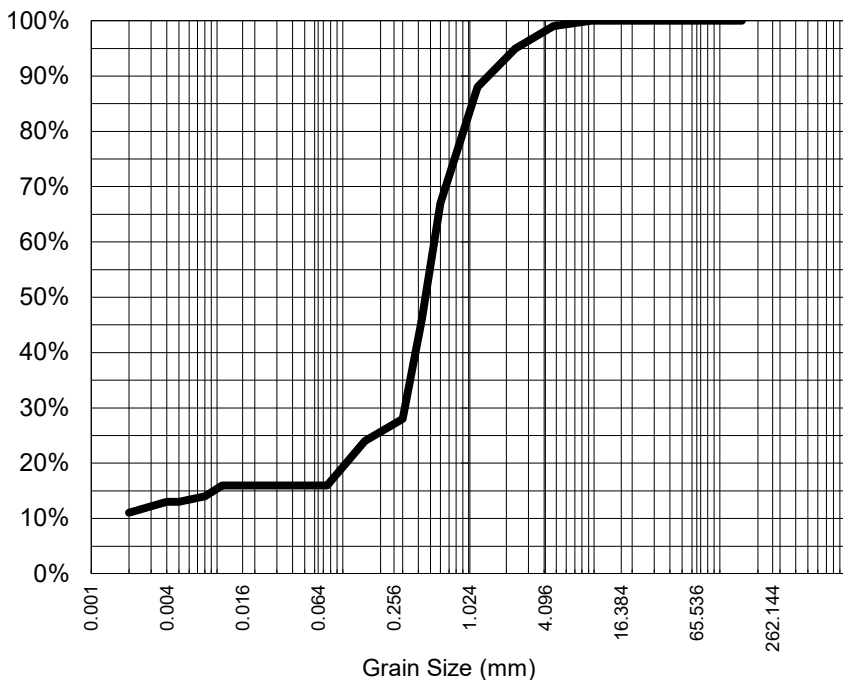
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Stafford, QLD 4053
pH 07 3243 7222
samples.brisbane@alsenviro.com

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Brisbane QLD



CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-010 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** C5 0.3

Particle Size Distribution



Analysis Notes

Samples analysed as received.

Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	95%
1.18	88%
0.600	67%
0.425	46%
0.300	28%
0.150	24%
0.075	16%
Particle Size (microns)	
60	16%
42	16%
30	16%
21	16%
15	16%
11	16%
8	14%
5	13%
2	11%

Median Particle Size (mm)*	0.458

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 17-Jun-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.58

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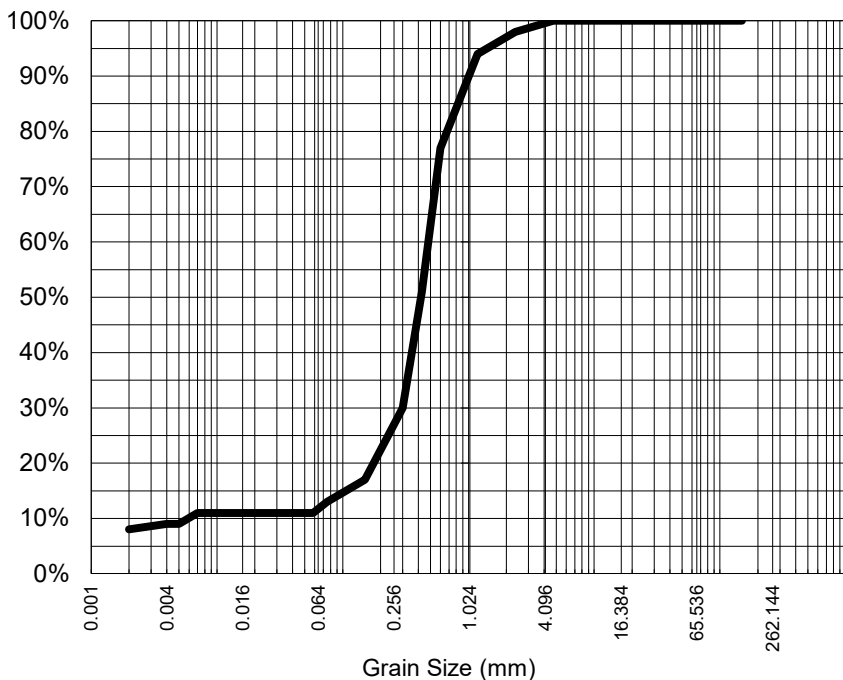
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Brisbane QLD



CLIENT: BRIONI ARMSTRONG **DATE REPORTED:** 26-Jun-2024
COMPANY: GHD PTY LTD **DATE RECEIVED:** 11-Jun-2024
ADDRESS: P O Box 930 **REPORT NO:** EB2419918-011 / PSD
Townsville
Qld, Australia
PROJECT: 12624084 GEMCO WQ Disposal **SAMPLE ID:** C6 0.3

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	94%
0.600	77%
0.425	51%
0.300	30%
0.150	17%
0.075	13%
Particle Size (microns)	
58	11%
41	11%
29	11%
20	11%
15	11%
11	11%
7	11%
5	9%
2	8%

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.419

Sample Comments:

Analysed: 17-Jun-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.65

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Satish Trivedi
Soil Senior Chemist
Authorised Signatory

Attachment 5

**QA/QC Water Quality Laboratory
Results**



QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB2419917	Page	: 1 of 11
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BRIONI ARMSTRONG	Telephone	: +61-7-3243 7222
Project	: 12624084 GEMCO WQ Disposal	Date Samples Received	: 11-Jun-2024
Site	: GROOTE EYLANDT, MILNER BAY	Issue Date	: 18-Jun-2024
Sampler	: Craig Chargulaf, Emma Raudonikis	No. of samples received	: 11
Order number	: ----	No. of samples analysed	: 11

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- Laboratory Control outliers exist - please see following pages for full details.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, where applicable to the methodology, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.

Page : 2 of 11
 Work Order : EB2419917
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP068B: Organophosphorus Pesticides (OP)	QC-5854510-002	----	Monocrotophos	6923-22-4	3.2 %	10.0-32.6%	Recovery less than lower control limit
Matrix Spike (MS) Recoveries							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EB2419863--001	Anonymous	Total Kjeldahl Nitrogen as N	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
I1 - 0.3,	I2 - 0.3,	----	----	----	12-Jun-2024	11-Jun-2024	1
I3 - 0.3,	I4 - 0.3,						
I5 - 0.3,	C1 - 0.3,						
C2 - 0.3,	C3 - 0.3,						
C4 - 0.3,	C5 - 0.3,						
C6 - 0.3							
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
I1 - 0.3,	I2 - 0.3,	----	----	----	12-Jun-2024	11-Jun-2024	1
I3 - 0.3,	I4 - 0.3,						
I5 - 0.3,	C1 - 0.3,						
C2 - 0.3,	C3 - 0.3,						
C4 - 0.3,	C5 - 0.3,						
C6 - 0.3							

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type		Count		Rate (%)		Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	15	6.67	10.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	9.09	10.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	11	9.09	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	6.67	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	15	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	11	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Quality Control Sample Type		Count		Rate (%)		Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS) - Continued						
Polychlorinated Biphenyls (PCB)	EP066	0	11	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results. This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein. Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters. Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Evaluation: ✖ = Holding time breach : ✔ = Within holding time

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Natural (EG020A-F)		09-Jun-2024	----	----	----	14-Jun-2024	06-Dec-2024	✓
I1 - 0.3,	I2 - 0.3,							
I3 - 0.3,	I4 - 0.3,							
I5 - 0.3,	C1 - 0.3,							
C2 - 0.3,	C3 - 0.3,							
C4 - 0.3,	C5 - 0.3,							
C6 - 0.3								
EG020T: Total Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)		09-Jun-2024	12-Jun-2024	06-Dec-2024	✓	13-Jun-2024	06-Dec-2024	✓
I1 - 0.3,	I2 - 0.3,							
I3 - 0.3,	I4 - 0.3,							
I5 - 0.3,	C1 - 0.3,							
C2 - 0.3,	C3 - 0.3,							
C4 - 0.3,	C5 - 0.3,							
C6 - 0.3								
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Natural (EG035F)		09-Jun-2024	----	----	----	14-Jun-2024	07-Jul-2024	✓
I1 - 0.3,	I2 - 0.3,							
I3 - 0.3,	I4 - 0.3,							
I5 - 0.3,	C1 - 0.3,							
C2 - 0.3,	C3 - 0.3,							
C4 - 0.3,	C5 - 0.3,							
C6 - 0.3								



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EG035T: Total Recoverable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	----	----	----	12-Jun-2024	07-Jul-2024	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	----	----	----	12-Jun-2024	07-Jul-2024	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	----	----	----	12-Jun-2024	11-Jun-2024	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	----	----	----	12-Jun-2024	07-Jul-2024	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	12-Jun-2024	07-Jul-2024	✓	12-Jun-2024	07-Jul-2024	✓



Matrix: WATER

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	12-Jun-2024	07-Jul-2024	✓	12-Jun-2024	07-Jul-2024	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	----	----	----	12-Jun-2024	11-Jun-2024	✗
EP066: Polychlorinated Biphenyls (PCB)								
Amber Glass Bottle - Unpreserved (EP066) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	18-Jun-2024	23-Jul-2024	✓
EP068A: Organochlorine Pesticides (OC)								
Amber Glass Bottle - Unpreserved (EP068) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	17-Jun-2024	23-Jul-2024	✓
EP068B: Organophosphorus Pesticides (OP)								
Amber Glass Bottle - Unpreserved (EP068) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	17-Jun-2024	23-Jul-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP075(SIM)A: Phenolic Compounds								
Amber Glass Bottle - Unpreserved (EP075(SIM)) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3,	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	14-Jun-2024	23-Jul-2024	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) C6 - 0.3		09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	15-Jun-2024	23-Jul-2024	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM)) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3,	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	14-Jun-2024	23-Jul-2024	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) C6 - 0.3		09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	15-Jun-2024	23-Jul-2024	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3, C6 - 0.3	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3,	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	15-Jun-2024	23-Jul-2024	✓
Amber VOC Vial - Sulfuric Acid (EP080) I1 - 0.3, I3 - 0.3, I5 - 0.3, C2 - 0.3, C4 - 0.3,	I2 - 0.3, I4 - 0.3, C1 - 0.3, C3 - 0.3, C5 - 0.3	09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	12-Jun-2024	23-Jun-2024	✓
Amber VOC Vial - Sulfuric Acid (EP080) C6 - 0.3		09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	13-Jun-2024	23-Jun-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) I1 - 0.3, I2 - 0.3, I3 - 0.3, I4 - 0.3, I5 - 0.3, C1 - 0.3, C2 - 0.3, C3 - 0.3, C4 - 0.3, C5 - 0.3, C6 - 0.3	09-Jun-2024	13-Jun-2024	16-Jun-2024	✓	15-Jun-2024	23-Jul-2024	✓
Amber VOC Vial - Sulfuric Acid (EP080) I1 - 0.3, I2 - 0.3, I3 - 0.3, I4 - 0.3, I5 - 0.3, C1 - 0.3, C2 - 0.3, C3 - 0.3, C4 - 0.3, C5 - 0.3	09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	12-Jun-2024	23-Jun-2024	✓
Amber VOC Vial - Sulfuric Acid (EP080) C6 - 0.3	09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	13-Jun-2024	23-Jun-2024	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) I1 - 0.3, I2 - 0.3, I3 - 0.3, I4 - 0.3, I5 - 0.3, C1 - 0.3, C2 - 0.3, C3 - 0.3, C4 - 0.3, C5 - 0.3	09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	12-Jun-2024	23-Jun-2024	✓
Amber VOC Vial - Sulfuric Acid (EP080) C6 - 0.3	09-Jun-2024	12-Jun-2024	23-Jun-2024	✓	13-Jun-2024	23-Jun-2024	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
Analytical Methods		QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	4	34	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	15	6.67	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	9.09	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	11	9.09	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	6.67	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	15	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	11	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	11	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH ₃ G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO ₂ - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM Schedule B(3)



Analytical Methods	Method	Matrix	Method Descriptions
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.



QUALITY CONTROL REPORT

Work Order	: EB2419917	Page	: 1 of 13
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BRIONI ARMSTRONG	Contact	: Nathan King
Address	: P O BOX 930 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 4771 5645	Telephone	: +61-7-3243 7222
Project	: 12624084 GEMCO WQ Disposal	Date Samples Received	: 11-Jun-2024
Order number	: ----	Date Analysis Commenced	: 12-Jun-2024
C-O-C number	: ----	Issue Date	: 18-Jun-2024
Sampler	: Craig Chargulaf, Emma Raudonikis		
Site	: GROOTE EYLANDT, MILNER BAY		
Quote number	: EB24GHDSE0025		
No. of samples received	: 11		
No. of samples analysed	: 11		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Morgan Lennox	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5853860)									
EB2419917-001	I1 0.3	EG020A-F: Cadmium	7440-43-9	0.0001 (0.0005)*	mg/L	<0.0005	<0.0005	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005 (0.025) *	mg/L	<0.025	<0.025	0.0	No Limit
EB2419930-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5851091)									

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 Work Order : EB2419917
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020T: Total Metals by ICP-MS (QC Lot: 5851091) - continued									
EB2419894-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001 (0.0005)*	mg/L	<0.0005	<0.0005	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Chromium	7440-47-3	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005 (0.026) *	mg/L	<0.026	<0.026	0.0	No Limit
EB2419917-004	I4 0.3	EG020A-T: Cadmium	7440-43-9	0.0001 (0.0005)*	mg/L	<0.0005	<0.0005	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Chromium	7440-47-3	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001 (0.005) *	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005 (0.026) *	mg/L	<0.026	<0.026	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 5853859)									
EB2419917-001	I1 0.3	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EB2419930-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5850564)									
EB2419894-002	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EB2419917-005	I5 0.3	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 5852129)									
EB2419838-004	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.03	0.0	No Limit
EB2419824-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.06	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 5852130)									
EB2419917-011	C6 0.3	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.08	0.08	0.0	No Limit
EB2419866-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.27	0.28	0.0	0% - 20%



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5852329)									
EB2419838-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2419917-006	C1 0.3	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5852125)									
EB2419838-004	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2419824-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.03	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5852126)									
EB2419917-011	C6 0.3	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2419866-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	1.63	1.68	2.5	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 5850387)									
EB2419917-005	I5 0.3	EK061G: Total Kjeldahl Nitrogen as N	----	0.1 (0.5)*	mg/L	<0.5	<0.5	0.0	No Limit
EB2419862-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	15.5	15.4	1.0	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5850386)									
EB2419917-005	I5 0.3	EK067G: Total Phosphorus as P	----	0.01 (0.05)*	mg/L	<0.05	<0.05	0.0	No Limit
EB2419862-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.30	0.30	0.0	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5852337)									
EB2419838-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2419917-006	C1 0.3	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 5854511)									
EB2419917-005	I5 0.3	EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	0.0	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5854510)									
EB2419917-005	I5 0.3	EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: 4,4'-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: 4,4'-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5854510) - continued									
EB2419917-005	I5 0.3	EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: 4,4'-DDT	50-29-3	2	µg/L	<2.0	<2.0	0.0	No Limit
		EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	<2.0	0.0	No Limit
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 5854510)									
EB2419917-005	I5 0.3	EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	<2.0	0.0	No Limit
		EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	<2.0	0.0	No Limit
		EP068: Parathion	56-38-2	2	µg/L	<2.0	<2.0	0.0	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 5854508)									
EB2419917-005	I5 0.3	EP075(SIM): Phenol	108-95-2	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2,4-Dimethylphenol	105-67-9	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2,4-Dichlorophenol	120-83-2	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2,6-Dichlorophenol	87-65-0	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2,4,6-Trichlorophenol	88-06-2	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 2,4,5-Trichlorophenol	95-95-4	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	2	µg/L	<2.0	<2.0	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP075(SIM)A: Phenolic Compounds (QC Lot: 5854508) - continued									
EB2419917-005	I5 0.3	EP075(SIM): Pentachlorophenol	87-86-5	2	µg/L	<2.0	<2.0	0.0	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 5854508)									
EB2419917-005	I5 0.3	EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	1	µg/L	<1.0	<1.0	0.0	No Limit
			205-82-3						
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	0.0	No Limit
		EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	<1.0	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5851221)									
EB2419908-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EB2419917-002	I2 0.3	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5854509)									
EB2419917-005	I5 0.3	EP071: C15 - C28 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	µg/L	<50	<50	0.0	No Limit
		EP071: C29 - C36 Fraction	----	50	µg/L	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5851221)									
EB2419908-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EB2419917-002	I2 0.3	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5854509)									
EB2419917-005	I5 0.3	EP071: >C10 - C16 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: >C16 - C34 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
EP080: BTEXN (QC Lot: 5851221)									
EB2419908-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080: BTEXN (QC Lot: 5851221) - continued									
EB2419908-001	Anonymous	EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
		106-42-3							
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
EB2419917-002	I2 0.3	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
		106-42-3							
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
	Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
		LCS	Low	High
Result				
<0.001	0.1 mg/L	101	88.0	116
<0.0001	0.1 mg/L	97.9	88.0	108
<0.001	0.1 mg/L	101	87.0	113
<0.001	0.1 mg/L	97.3	88.0	114
<0.001	0.1 mg/L	94.0	89.0	110
<0.001	0.1 mg/L	96.6	89.0	113
<0.005	0.1 mg/L	96.3	87.0	113
<0.001	0.1 mg/L	102	88.0	112
<0.0001	0.1 mg/L	98.3	88.0	111
<0.001	0.1 mg/L	103	89.0	115
<0.001	0.1 mg/L	97.8	88.0	116
<0.001	0.1 mg/L	99.8	89.0	112
<0.001	0.1 mg/L	100	88.0	116
<0.005	0.1 mg/L	99.6	84.0	114
<0.0001	0.01 mg/L	93.7	84.0	118
<0.0001	0.01 mg/L	98.9	84.0	118
<0.01	0.5 mg/L	97.0	83.5	114
<0.01	0.5 mg/L	96.8	83.5	114
<0.01	0.5 mg/L	99.3	90.0	110
<0.01	0.5 mg/L	97.4	85.7	111
<0.01	0.5 mg/L	97.0	85.7	111

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5850387) - continued								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	1 mg/L	92.5	70.1	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5850386)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	99.7	84.7	106
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5852337)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	93.6	81.7	117
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 5854511)								
EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1	10 µg/L	76.6	55.0	131
EP068A: Organochlorine Pesticides (OC) (QCLot: 5854510)								
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	83.2	60.3	131
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	71.8	45.1	126
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	90.9	63.1	128
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	80.7	60.2	130
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	87.0	58.6	120
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	71.7	53.8	118
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	79.2	53.7	120
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	96.7	57.0	122
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	71.1	56.3	121
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	74.4	56.5	123
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	69.7	55.8	122
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	75.8	55.3	124
EP068: 4,4`-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	72.5	52.8	122
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	76.5	48.9	131
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	88.4	50.0	121
EP068: 4,4`-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	75.8	46.5	123
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	69.6	42.0	122
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	82.2	49.8	130
EP068: 4,4`-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	68.0	39.4	134
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	84.6	51.4	129
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	77.2	45.7	139
EP068: Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----
EP068: Sum of DDD + DDE + DDT	72-54-8/72-5 5-9/50-2	0.5	µg/L	<0.5	----	----	----	----
EP068: Sum of Aldrin + Dieldrin	309-00-2/60- 57-1	0.5	µg/L	<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP) (QCLot: 5854510)								



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP068B: Organophosphorus Pesticides (OP) (QCLot: 5854510) - continued								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	81.4	53.2	133
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	82.2	44.2	158
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	# 3.2	10.0	32.6
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	73.8	27.6	153
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	78.9	53.6	128
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	78.8	51.6	122
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	78.5	45.2	139
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	82.5	47.5	135
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	72.1	53.4	133
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	72.8	56.3	125
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	79.1	37.1	144
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	70.4	49.8	131
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	77.4	37.0	131
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	73.3	47.3	127
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	73.0	16.0	150
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	76.5	45.5	128
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	82.3	39.1	129
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	81.2	38.4	134
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	81.8	27.5	146
EP075(SIM)A: Phenolic Compounds (QCLot: 5854508)								
EP075(SIM): Phenol	108-95-2	1	µg/L	<1.0	10 µg/L	37.4	20.0	48.0
EP075(SIM): 2-Chlorophenol	95-57-8	1	µg/L	<1.0	10 µg/L	86.2	56.0	110
EP075(SIM): 2-Methylphenol	95-48-7	1	µg/L	<1.0	10 µg/L	76.8	48.0	99.0
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	2	µg/L	<2.0	20 µg/L	72.6	43.0	93.0
EP075(SIM): 2-Nitrophenol	88-75-5	1	µg/L	<1.0	10 µg/L	100	37.0	130
EP075(SIM): 2,4-Dimethylphenol	105-67-9	1	µg/L	<1.0	10 µg/L	93.8	53.0	121
EP075(SIM): 2,4-Dichlorophenol	120-83-2	1	µg/L	<1.0	10 µg/L	87.8	56.0	120
EP075(SIM): 2,6-Dichlorophenol	87-65-0	1	µg/L	<1.0	10 µg/L	88.3	57.0	117
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	10 µg/L	90.8	48.0	116
EP075(SIM): 2,4,6-Trichlorophenol	88-06-2	1	µg/L	<1.0	10 µg/L	97.4	48.0	125
EP075(SIM): 2,4,5-Trichlorophenol	95-95-4	1	µg/L	<1.0	10 µg/L	98.8	45.0	123
EP075(SIM): Pentachlorophenol	87-86-5	2	µg/L	<2.0	20 µg/L	98.8	16.0	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 5854508)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	10 µg/L	89.3	50.0	110



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 5854508) - continued								
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	10 µg/L	88.0	49.0	124
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	10 µg/L	77.6	55.0	114
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	10 µg/L	83.0	55.0	119
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	10 µg/L	84.7	51.0	127
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	10 µg/L	87.3	55.0	127
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	10 µg/L	81.5	55.0	127
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	10 µg/L	79.3	54.0	126
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	10 µg/L	88.6	47.0	136
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	10 µg/L	87.9	51.0	129
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	10 µg/L	110	55.0	132
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	10 µg/L	94.3	58.0	128
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	10 µg/L	102	55.0	131
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	10 µg/L	93.2	52.0	133
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	10 µg/L	90.6	48.0	137
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	10 µg/L	98.0	53.0	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5851221)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	180 µg/L	103	77.0	122
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5854509)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	1192 µg/L	71.8	51.9	126
EP071: C15 - C28 Fraction	----	100	µg/L	<100	1390 µg/L	76.4	51.4	124
EP071: C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5851221)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	225 µg/L	101	76.0	121
EP080: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTE X	20	µg/L	<20	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5854509)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	1592 µg/L	74.3	51.0	133
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	932 µg/L	75.3	49.5	123
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN (QCLot: 5851221)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	103	79.8	115
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	100	78.6	116
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	99.6	77.3	115

Matrix Spike (MS) Report

Sub-Matrix: WATER

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5853860)							
EB2419917-002	I2 0.3	EG020A-F: Arsenic	7440-38-2	1 mg/L	101	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	92.3	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	96.2	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	90.5	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	102	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	92.3	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.5	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5851091)							
EB2419894-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	108	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	92.0	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	104	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	102	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	94.9	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	102	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	97.8	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 5853859)							
EB2419917-002	I2 0.3	EG035F: Mercury	7439-97-6	0.01 mg/L	83.8	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5850564)							
EB2419894-001	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	74.4	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5852129)							
EB2419838-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	94.6	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5852130)							

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 Work Order : EB2419917
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5852130) - continued							
EB2419917-002	I2 0.3	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	115	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5852329)							
EB2419917-001	I1 0.3	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	92.0	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5852125)							
EB2419838-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	96.0	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5852126)							
EB2419917-002	I2 0.3	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	99.3	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5850387)							
EB2419863-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	# Not Determined	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5850386)							
EB2419863-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	96.5	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5852337)							
EB2419917-001	I1 0.3	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	90.8	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5851221)							
EB2419908-002	Anonymous	EP080: C6 - C9 Fraction	----	40 µg/L	104	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5854509)							
EB2419917-005	I5 0.3	EP071: C10 - C14 Fraction	----	1192 µg/L	87.2	49.0	134
		EP071: C15 - C28 Fraction	----	1390 µg/L	87.4	50.0	132
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5851221)							
EB2419908-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	40 µg/L	102	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5854509)							
EB2419917-005	I5 0.3	EP071: >C10 - C16 Fraction	----	1592 µg/L	88.8	43.0	119
		EP071: >C16 - C34 Fraction	----	932 µg/L	88.4	38.0	114
EP080: BTEXN (QCLot: 5851221)							
EB2419908-002	Anonymous	EP080: Benzene	71-43-2	10 µg/L	108	70.0	130
		EP080: Toluene	108-88-3	10 µg/L	105	70.0	130

Mandatory Fields				CHAIN OF CUSTODY												Page 2 of 2																															
CLIENT CODE:				*PROJECT MANAGER: Brioni Armstrong				SAMPLER: Craig Chargulaf / Emma Raudonikis								CoC #: (if applicable)																															
*CLIENT: GHD				*PM MOBILE: 427832804				SAMPLER MOBILE: 0416 492 813																																							
OFFICE: (Invoiced Office) Townsville				ALS QUOTE #: (Client PL if blank) EB24GHDSE0025				PURCHASE ORDER NO.:																																							
PROJECT NO./PROJECT: 12624084 GEMCO WQ Disposal				SITE: Groote Eylandt, Milner Bay																																											
*INVOICE TO: (Client default if nil) Brioni.Armstrong@ghd.com				CC Invoice to PM																																											
*EMAIL REPORTS TO: (default to PM if blank) Brioni.Armstrong@ghd.com Tristram.Coffin@ghd.com Jason.fowler2@ghd.com				*ANALYSIS REQUIRED (NB. ALS Quote No. and/or Analysis Suite Codes must be listed to attract suite/quoted price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required). Mark an X in the boxes below analysis to indicate the parameter listed above to be tested on that sample.																																											
* STORAGE REQUIREMENTS Please check box: → Standard Storage time from receipt of samples: Waters - 3 weeks Soils - 2 months ☒ Standard Storage ☐ Extended Storage Specify Disposal Date: Note: Extended storage incurs a fee and requires a signed agreement.				* TURNAROUND Please check box: → (Not all tests can be expedited, contact Client Services for more information) ☒ 5+ days (no surcharge) ☐ 3 day (+15%) ☐ 2 day (+30%) ☐ 1 day (+50%)																																											
Comments:																																															
ALS Use Only				Sample ID				Depth				Date/Time				No. Bottles				MATRIX: Soil/Solid(S) Water(W) Sediments (SD), Dust (D), Product (P), Bios (B), Biosolid (BS)								Lab QC (additional bottles req.)				Additional Information (Comment on hazards - e.g., asbestos, known high contamination)															
Lab ID																								Dup				MS																			
1				I1				0.3				9/5/24 @ 07:00				7				W				X				X				X				□				□				Please lab filter dissolved metals			
2				I2				0.3				9/6/24 @ 07:25				7				W				X				X				X				□				□				Please lab filter dissolved metals			
3				I3				0.3				9/6/24 @ 07:40				7				W				X				X				X				□				□				Please lab filter dissolved metals			
4				I4				0.3				9/6/24 @ 07:50				7				W				X				X				X				□				□				Please lab filter dissolved metals			
5				I5				0.3				9/6/24 @ 07:55				7				W				X				X				X				□				□				Please lab filter dissolved metals			
6				C1				0.3				9/6/24 @ 08:10				7				W				X				X				X				□				□				Please lab filter dissolved metals			
7				C2				0.3				9/6/24 @ 08:25				7				W				X				X				X				□				□				Please lab filter dissolved metals			
8				C3				0.3				9/6/24 @ 08:40				7				W				X				X				X				□				□				Please lab filter dissolved metals			
9				C4				0.3				9/6/24 @ 09:00				7				W				X				X				X				□				□				Please lab filter dissolved metals			
10				C5				0.3				9/6/24 @ 09:10				7				W				X				X				X				□				□				Please lab filter dissolved metals			
11				C6				0.3				9/6/24 @ 09:20				7				W				X				X				X				□				□				Please lab filter dissolved metals			
Receipt Detail (Lab Use ONLY)				Chilling Method: Ice: Ice Bricks: Frozen / Melted Frozen / Thawso None				Sample Temp at Receipt °C °C °C				Security Seal Intact (circle) Yes / No / NA(Non)				Carrier Details □ Courier/Post □ Client				Packaging: (Circle) Count # # #				Hard Esky Foam Esky Box/Bag/Other																							
Relinquished by: Craig Chargulaf				Signature: [Signature]				Date/Time: 11/9/24				Received by: [Signature]				Signature: [Signature]				Date/Time: 11/6 1753																											
Relinquished by:				Signature:				Date/Time:				Received by:				Signature:				Date/Time:																											

Attachment 6

QA/QC Sediment Laboratory Results



QUALITY CONTROL REPORT

Work Order	: EB2419918	Page	: 1 of 16
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BRIONI ARMSTRONG	Contact	: Nathan King
Address	: P O BOX 930 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 4771 5645	Telephone	: +61-7-3243 7222
Project	: 12624084 GEMCO WQ Disposal	Date Samples Received	: 11-Jun-2024
Order number	: ----	Date Analysis Commenced	: 14-Jun-2024
C-O-C number	: ----	Issue Date	: 26-Jun-2024
Sampler	: Craig Chargulaf, Emma Raudonikis		
Site	: ----		
Quote number	: EB24GHDSE0025		
No. of samples received	: 11		
No. of samples analysed	: 11		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Morgan Lennox	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot

CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

RPD = Relative Percentage Difference

= Indicates failed QC

* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5868939)									
EB2419331-001	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	7	7	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	16	17	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	11	11	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	12	12	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	14	15	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	47	48	3.0	No Limit
EB2419331-011	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	4	4	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	9	9	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	10	10	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	6	6	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	15	15	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	35	35	0.0	No Limit
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5868941)									
EB2419918-007	C2 0.3	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	16	16	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	8	7	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit

Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5868941) - continued									
EB2419918-007	C2 0.3	EG005T: Zinc	7440-66-6	5	mg/kg	<5	<5	0.0	No Limit
EB2420619-006	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	9	11	23.6	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	35	40	11.0	0% - 50%
		EG005T: Arsenic	7440-38-2	5	mg/kg	14	13	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	29	28	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	9	8	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	36	50	31.8	0% - 50%
EK055-P: Ammonia as N (QC Lot: 5868719)									
EB2419776-001	Anonymous	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EB2419918-002	I2 0.3	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EA033-A: Actual Acidity (QC Lot: 5874166)									
EB2419918-001	I1 0.3	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	9.4	9.4	0.0	0% - 20%
EB2420619-006	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	5	5	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	5.8	5.8	0.0	0% - 20%
EA033-B: Potential Acidity (QC Lot: 5874166)									
EB2419918-001	I1 0.3	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.012	0.012	0.0	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2420619-006	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	1.39	1.42	1.8	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	870	886	1.8	0% - 20%
EA033-C: Acid Neutralising Capacity (QC Lot: 5874166)									
EB2419918-001	I1 0.3	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	22.1	21.6	2.3	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	7.07	6.91	2.3	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	4410	4310	2.3	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 5874852)									
EB2419918-001	I1 0.3	EA037: pH (F)	----	0.1	pH Unit	8.6	8.7	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	9.4	9.5	0.0	0% - 20%
EB2420962-009	Anonymous	EA037: pH (F)	----	0.1	pH Unit	6.5	6.5	0.0	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.5	3.4	5.2	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5859024)									



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5859024) - continued									
EB2419918-001	I1 0.3	EA055: Moisture Content	----	0.1 (1.0)*	%	32.4	32.7	0.8	0% - 20%
EB2419918-011	C6 0.3	EA055: Moisture Content	----	0.1 (1.0)*	%	36.1	38.4	6.3	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5868938)									
EB2419331-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2419331-011	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5868940)									
EB2419918-007	C2 0.3	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2420619-006	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	1.2	1.0	12.4	0% - 50%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5859020)									
EB2419918-001	I1 0.3	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2419918-011	C6 0.3	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5859022)									
EB2419918-001	I1 0.3	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.2	0.2	0.0	No Limit
EB2419918-011	C6 0.3	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	1.3	1.4	0.0	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 5868933)									
EB2419331-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	780	770	1.7	0% - 20%
EB2419331-011	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	1200	# 970	21.0	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 5868935)									
EB2419918-007	C2 0.3	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	460	# 1800000	200	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5868934)									
EB2419331-001	Anonymous	EK067G: Total Phosphorus as P	----	2	mg/kg	250	281	11.6	0% - 20%
EB2419331-011	Anonymous	EK067G: Total Phosphorus as P	----	2	mg/kg	206	# 167	20.7	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5868936)									
EB2419918-007	C2 0.3	EK067G: Total Phosphorus as P	----	2	mg/kg	192	169	12.5	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5859021)									
EB2419918-001	I1 0.3	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.2	0.2	0.0	No Limit
EB2419918-011	C6 0.3	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.3	0.2	0.0	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 5859017)									
EB2419918-001	I1 0.3	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2419918-011	C6 0.3	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5859016)									
EB2419918-001	I1 0.3	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5859016) - continued									
EB2419918-001	I1 0.3	EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EB2419918-011	C6 0.3	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5859016) - continued									
EB2419918-011	C6 0.3	EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 5859016)									
EB2419918-001	I1 0.3	EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EB2419918-011	C6 0.3	EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit

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 Work Order : EB2419918
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 5859016) - continued									
EB2419918-011	C6 0.3	EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 5859015)									
EB2419918-001	I1 0.3	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4,6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4,5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.0	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.0	No Limit
EB2419918-011	C6 0.3	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4,6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2,4,5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.0	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.0	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 5859015)									
EB2419918-001	I1 0.3	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 5859015) - continued									
EB2419918-001	I1 0.3	EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
			205-82-3						
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EB2419918-011	C6 0.3	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
			205-82-3						
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5859014)									
EB2419918-001	I1 0.3	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit

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 Work Order : EB2419918
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5859014) - continued									
EB2419918-001	I1 0.3	EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2419918-011	C6 0.3	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5859019)									
EB2419918-001	I1 0.3	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EB2419918-011	C6 0.3	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5859014)									
EB2419918-001	I1 0.3	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2419918-011	C6 0.3	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5859019)									
EB2419918-001	I1 0.3	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EB2419918-011	C6 0.3	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EP080: BTEXN (QC Lot: 5859019)									
EB2419918-001	I1 0.3	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EB2419918-011	C6 0.3	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5868939)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	57.6 mg/kg	112	84.0	123
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	12.8 mg/kg	120	83.0	125
EG005T: Copper	7440-50-8	5	mg/kg	<5	35 mg/kg	113	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	41.7 mg/kg	119	84.0	119
EG005T: Nickel	7440-02-0	2	mg/kg	<2	10.8 mg/kg	104	81.5	118
EG005T: Zinc	7440-66-6	5	mg/kg	<5	143 mg/kg	120	80.0	120
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5868941)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	57.6 mg/kg	113	84.0	123
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	12.8 mg/kg	120	83.0	125
EG005T: Copper	7440-50-8	5	mg/kg	<5	35 mg/kg	112	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	41.7 mg/kg	99.6	84.0	119
EG005T: Nickel	7440-02-0	2	mg/kg	<2	10.8 mg/kg	104	81.5	118
EG005T: Zinc	7440-66-6	5	mg/kg	<5	143 mg/kg	114	80.0	120
EK055-P: Ammonia as N (QCLot: 5868719)								
EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	92.1	90.0	110
EA033-A: Actual Acidity (QCLot: 5874166)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.7 pH Unit	102	80.0	120
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	109	80.0	120
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 5874166)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.2 % S	104	77.0	121
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 5874166)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	104	91.0	112
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5868938)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.10183 mg/kg	102	70.0	125



Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5868940)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.10183 mg/kg	92.9	70.0	125
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5859020)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	98.0	83.0	111
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5859022)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	95.1	83.2	111
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5868933)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	106	70.0	130
				<20	2180 mg/kg	81.5	72.0	128
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5868935)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	109	70.0	130
				<20	2180 mg/kg	82.7	72.0	128
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5868934)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	96.6	70.0	130
				<2	1200 mg/kg	87.9	79.0	121
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5868936)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	98.7	70.0	130
				<2	1200 mg/kg	104	79.0	121
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5859021)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	99.9	84.3	112
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 5859017)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	78.7	71.6	155
EP068A: Organochlorine Pesticides (OC) (QCLot: 5859016)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	97.9	72.8	127
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	77.1	71.0	127
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	98.7	67.5	126
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	81.8	72.7	127
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	107	70.6	122
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	86.5	64.8	127
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	83.0	72.4	122
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	81.7	67.4	125
EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	88.0	65.6	124
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	90.8	70.4	122
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	91.9	65.6	125



Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP068A: Organochlorine Pesticides (OC) (QCLot: 5859016) - continued								
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	82.1	69.1	124
EP068: 4,4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	83.9	72.4	125
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	80.1	63.2	127
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	86.6	69.7	120
EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
EP068: 4,4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	106	61.2	124
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	91.8	55.5	125
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	64.5	57.1	117
EP068: 4,4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	87.3	51.9	125
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	55.5	46.5	122
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	90.2	34.0	130
EP068: Sum of DDD + DDE + DDT	72-54-8/72-5 5-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP068: Sum of Aldrin + Dieldrin	309-00-2/60- 57-1	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP) (QCLot: 5859016)								
EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	0.5 mg/kg	90.2	55.8	126
EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	86.4	45.9	136
EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	0.5 mg/kg	78.0	20.0	147
EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	0.5 mg/kg	94.2	44.1	125
EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	0.5 mg/kg	77.4	70.3	125
EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	0.5 mg/kg	79.7	63.2	124
EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	0.5 mg/kg	83.9	44.2	129
EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	0.5 mg/kg	69.0	52.3	133
EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	0.5 mg/kg	76.9	62.9	126
EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	0.5 mg/kg	94.9	69.2	123
EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	0.5 mg/kg	81.7	37.6	138
EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	0.5 mg/kg	77.2	59.6	131
EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	0.5 mg/kg	97.3	46.4	144
EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	0.5 mg/kg	68.0	56.8	128
EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	0.5 mg/kg	50.2	24.4	135
EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	0.5 mg/kg	94.1	55.9	123
EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	0.5 mg/kg	92.1	45.0	138
EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	0.5 mg/kg	58.7	41.6	141
EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	0.5 mg/kg	34.6	20.0	145



Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP075(SIM)A: Phenolic Compounds (QCLot: 5859015)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	1.5 mg/kg	91.7	78.0	134
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	1.5 mg/kg	89.8	78.0	132
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	1.5 mg/kg	89.8	78.0	132
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	3 mg/kg	91.6	77.2	135
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	1.5 mg/kg	85.6	42.9	156
EP075(SIM): 2,4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	1.5 mg/kg	92.7	70.3	141
EP075(SIM): 2,4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	1.5 mg/kg	91.6	69.9	135
EP075(SIM): 2,6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	1.5 mg/kg	91.1	72.9	136
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	1.5 mg/kg	99.7	53.3	138
EP075(SIM): 2,4,6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	1.5 mg/kg	84.0	50.9	140
EP075(SIM): 2,4,5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	1.5 mg/kg	102	45.5	140
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	3 mg/kg	21.4	20.0	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 5859015)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	1.5 mg/kg	88.8	72.6	133
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	1.5 mg/kg	105	63.2	144
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	1.5 mg/kg	83.8	66.0	132
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	1.5 mg/kg	86.6	76.2	134
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	1.5 mg/kg	89.5	71.8	137
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	1.5 mg/kg	89.1	77.1	143
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	1.5 mg/kg	88.1	74.1	140
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	1.5 mg/kg	90.4	72.0	139
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	1.5 mg/kg	89.5	58.0	145
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	1.5 mg/kg	89.5	63.0	147
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	1.5 mg/kg	92.1	70.5	142
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	1.5 mg/kg	92.7	75.5	138
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	1.5 mg/kg	91.6	68.5	140
EP075(SIM): Indeno(1,2,3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	1.5 mg/kg	85.8	58.4	143
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	1.5 mg/kg	78.8	52.1	149
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	1.5 mg/kg	80.9	64.6	140
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5859014)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	378 mg/kg	109	63.3	125
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	407 mg/kg	108	56.1	122
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----

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 Work Order : EB2419918
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
						LCS	Low	High
Method: Compound	CAS Number	LOR	Unit	Result				
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5859019)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	18 mg/kg	99.1	64.0	120
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5859014)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	502 mg/kg	108	61.2	132
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	268 mg/kg	109	52.6	130
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5859019)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	22.5 mg/kg	106	58.1	124
EP080: BTEXN (QCLot: 5859019)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	89.8	68.0	107
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	84.4	69.0	108
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	88.6	68.0	109
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	90.4	70.0	114
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	91.5	74.0	116
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	81.4	74.0	109

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: SOIL				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5868939)							
EB2419331-002	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	96.8	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	90.0	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	91.3	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	92.7	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	80.5	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	76.6	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	86.8	70.0	130
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5868941)							
EB2419918-008	C3 0.3	EG005T: Arsenic	7440-38-2	50 mg/kg	93.8	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	84.1	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	# 68.1	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	94.1	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	77.6	70.0	130

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 Work Order : EB2419918
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: SOIL				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5868941) - continued							
EB2419918-008	C3 0.3	EG005T: Nickel	7440-02-0	50 mg/kg	73.8	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	81.7	70.0	130
EK055-P: Ammonia as N (QCLot: 5868719)							
EB2419776-002	Anonymous	EK055-P: Ammonia as N	7664-41-7	100 mg/kg	79.4	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5868938)							
EB2419331-002	Anonymous	EG035T: Mercury	7439-97-6	0.5 mg/kg	94.5	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5868940)							
EB2419918-008	C3 0.3	EG035T: Mercury	7439-97-6	0.5 mg/kg	99.9	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5859020)							
EB2419918-002	I2 0.3	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	74.7	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5859022)							
EB2419918-002	I2 0.3	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	97.3	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5868933)							
EB2419331-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	92.6	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5868935)							
EB2419918-008	C3 0.3	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	83.2	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5868934)							
EB2419331-002	Anonymous	EK067G: Total Phosphorus as P	----	100 mg/kg	117	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5868936)							
EB2419918-008	C3 0.3	EK067G: Total Phosphorus as P	----	100 mg/kg	# 207	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5859021)							
EB2419918-002	I2 0.3	EK071G: Reactive Phosphorus as P	14265-44-2	2.5 mg/kg	92.8	70.0	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 5859017)							
EB2419918-002	I2 0.3	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	76.0	70.0	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 5859016)							
EB2419918-002	I2 0.3	EP068: gamma-BHC	58-89-9	0.5 mg/kg	79.1	70.0	136
		EP068: Heptachlor	76-44-8	0.5 mg/kg	86.5	65.0	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	82.9	70.0	130
		EP068: Dieldrin	60-57-1	0.5 mg/kg	82.8	67.0	129
		EP068: Endrin	72-20-8	0.5 mg/kg	82.5	60.0	137
		EP068: 4,4'-DDT	50-29-3	0.5 mg/kg	96.2	70.0	130
EP068B: Organophosphorus Pesticides (OP) (QCLot: 5859016)							
EB2419918-002	I2 0.3	EP068: Diazinon	333-41-5	0.5 mg/kg	74.4	70.0	131
		EP068: Chlorpyrifos-methyl	5598-13-0	0.5 mg/kg	79.2	70.0	130

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 Work Order : EB2419918
 Client : GHD PTY LTD
 Project : 12624084 GEMCO WQ Disposal



Sub-Matrix: SOIL				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 5859016) - continued							
EB2419918-002	I2 0.3	EP068: Pirimphos-ethyl	23505-41-1	0.5 mg/kg	77.7	70.0	130
		EP068: Bromophos-ethyl	4824-78-6	0.5 mg/kg	73.7	70.0	130
		EP068: Prothiofos	34643-46-4	0.5 mg/kg	96.5	70.0	134
EP075(SIM)A: Phenolic Compounds (QCLot: 5859015)							
EB2419918-002	I2 0.3	EP075(SIM): Phenol	108-95-2	1.5 mg/kg	103	70.0	130
		EP075(SIM): 2-Chlorophenol	95-57-8	1.5 mg/kg	90.3	70.0	130
		EP075(SIM): 2-Nitrophenol	88-75-5	1.5 mg/kg	90.4	42.9	156
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	1.5 mg/kg	96.4	53.3	138
		EP075(SIM): Pentachlorophenol	87-86-5	3 mg/kg	47.8	20.0	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 5859015)							
EB2419918-002	I2 0.3	EP075(SIM): Acenaphthene	83-32-9	1.5 mg/kg	86.5	66.0	132
		EP075(SIM): Pyrene	129-00-0	1.5 mg/kg	92.4	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5859014)							
EB2419918-002	I2 0.3	EP071: C10 - C14 Fraction	----	379 mg/kg	106	70.0	130
		EP071: C15 - C28 Fraction	----	407 mg/kg	107	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5859019)							
EB2419918-002	I2 0.3	EP080: C6 - C9 Fraction	----	8 mg/kg	73.2	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5859014)							
EB2419918-002	I2 0.3	EP071: >C10 - C16 Fraction	----	502 mg/kg	106	70.0	130
		EP071: >C16 - C34 Fraction	----	268 mg/kg	110	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5859019)							
EB2419918-002	I2 0.3	EP080: C6 - C10 Fraction	C6_C10	8 mg/kg	74.4	70.0	130
EP080: BTEXN (QCLot: 5859019)							
EB2419918-002	I2 0.3	EP080: Benzene	71-43-2	2 mg/kg	89.1	70.0	130
		EP080: Toluene	108-88-3	2 mg/kg	84.9	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

Work Order : **EB2419918**

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Client : **GHD PTY LTD**
Contact : **MS BRIONI ARMSTRONG**
Project : **12624084 GEMCO WQ Disposal**
Site : **----**
Sampler : **Craig Chargulaf, Emma Raudonikis**
Order number : **----**

Laboratory : **Environmental Division Brisbane**
Telephone : **+61-7-3243 7222**
Date Samples Received : **11-Jun-2024**
Issue Date : **26-Jun-2024**
No. of samples received : **11**
No. of samples analysed : **11**

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- Duplicate outliers exist - please see following pages for full details.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, where applicable to the methodology, **NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: SOIL

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EB2419918--007	C2 0.3	Total Kjeldahl Nitrogen as N	----	200 %	0% - 20%	RPD exceeds LOR based limits
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EB2419331--011	Anonymous	Total Kjeldahl Nitrogen as N	----	21.0 %	0% - 20%	RPD exceeds LOR based limits
EK067G: Total Phosphorus as P by Discrete Analyser	EB2419331--011	Anonymous	Total Phosphorus as P	----	20.7 %	0% - 20%	RPD exceeds LOR based limits
Matrix Spike (MS) Recoveries							
EG005(ED093)T: Total Metals by ICP-AES	EB2419918--008	C3 0.3	Chromium	7440-47-3	68.1 %	70.0-130%	Recovery less than lower data quality objective
EK067G: Total Phosphorus as P by Discrete Analyser	EB2419918--008	C3 0.3	Total Phosphorus as P	----	207 %	70.0-130%	Recovery greater than upper data quality objective

Outliers : Analysis Holding Time Compliance

Matrix: SOIL

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Soil Glass Jar - Unpreserved		19-Jun-2024	16-Jun-2024	3	----	----	----
I1 0.3,	I2 0.3,						
I3 0.3,	I4 0.3,						
I5 0.3,	C1 0.3,						
C2 0.3,	C3 0.3,						
C4 0.3,	C5 0.3,						
C6 0.3							
EK071G: Reactive Phosphorus as P by discrete analyser							
Soil Glass Jar - Unpreserved		19-Jun-2024	16-Jun-2024	3	----	----	----
I1 0.3,	I2 0.3,						
I3 0.3,	I4 0.3,						
I5 0.3,	C1 0.3,						
C2 0.3,	C3 0.3,						
C4 0.3,	C5 0.3,						
C6 0.3							

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA033-A: Actual Acidity								
Snap Lock Bag - frozen (EA033) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	09-Jun-2025	✓	24-Jun-2024	22-Sep-2024	✓
EA033-B: Potential Acidity								
Snap Lock Bag - frozen (EA033) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	09-Jun-2025	✓	24-Jun-2024	22-Sep-2024	✓
EA033-C: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA033) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	09-Jun-2025	✓	24-Jun-2024	22-Sep-2024	✓
EA033-D: Retained Acidity								
Snap Lock Bag - frozen (EA033) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	09-Jun-2025	✓	24-Jun-2024	22-Sep-2024	✓
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	09-Jun-2025	✓	24-Jun-2024	22-Sep-2024	✓
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen (EA037) I1 0.3, I3 0.3, C3 0.3	I2 0.3, I4 0.3,	09-Jun-2024	24-Jun-2024	06-Dec-2024	✓	24-Jun-2024	06-Dec-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)							
I1 0.3, I2 0.3, I3 0.3, I4 0.3, I5 0.3, C1 0.3, C2 0.3, C3 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	----	----	----	14-Jun-2024	23-Jun-2024	✓
EA150: Particle Sizing							
Snap Lock Bag - frozen (EA150H)							
I5 0.3, C1 0.3, C2 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	----	----	----	26-Jun-2024	06-Dec-2024	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag - frozen (EA150H)							
I5 0.3, C1 0.3, C2 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	----	----	----	26-Jun-2024	06-Dec-2024	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
I1 0.3, I2 0.3, I3 0.3, I4 0.3, I5 0.3, C1 0.3, C2 0.3, C3 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	20-Jun-2024	06-Dec-2024	✓	21-Jun-2024	06-Dec-2024	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
I1 0.3, I2 0.3, I3 0.3, I4 0.3, I5 0.3, C1 0.3, C2 0.3, C3 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	20-Jun-2024	07-Jul-2024	✓	22-Jun-2024	07-Jul-2024	✓
EK055-P: Ammonia as N							
Soil Glass Jar - Unpreserved (EK055-P)							
I1 0.3, I2 0.3, I3 0.3, I4 0.3, I5 0.3, C1 0.3, C2 0.3, C3 0.3, C4 0.3, C5 0.3, C6 0.3	09-Jun-2024	----	----	----	19-Jun-2024	07-Jul-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK057G: Nitrite as N by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK057G)							
I1 0.3, I2 0.3,	09-Jun-2024	19-Jun-2024	16-Jun-2024	✗	19-Jun-2024	21-Jun-2024	✓
I3 0.3, I4 0.3,							
I5 0.3, C1 0.3,							
C2 0.3, C3 0.3,							
C4 0.3, C5 0.3,							
C6 0.3							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G)							
I1 0.3, I2 0.3,	09-Jun-2024	19-Jun-2024	07-Jul-2024	✓	19-Jun-2024	21-Jun-2024	✓
I3 0.3, I4 0.3,							
I5 0.3, C1 0.3,							
C2 0.3, C3 0.3,							
C4 0.3, C5 0.3,							
C6 0.3							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G)							
I1 0.3, I2 0.3,	09-Jun-2024	20-Jun-2024	07-Jul-2024	✓	20-Jun-2024	18-Jul-2024	✓
I3 0.3, I4 0.3,							
I5 0.3, C1 0.3,							
C2 0.3, C3 0.3,							
C4 0.3, C5 0.3,							
C6 0.3							
EK067G: Total Phosphorus as P by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK067G)							
I1 0.3, I2 0.3,	09-Jun-2024	20-Jun-2024	07-Jul-2024	✓	20-Jun-2024	18-Jul-2024	✓
I3 0.3, I4 0.3,							
I5 0.3, C1 0.3,							
C2 0.3, C3 0.3,							
C4 0.3, C5 0.3,							
C6 0.3							
EK071G: Reactive Phosphorus as P by discrete analyser							
Soil Glass Jar - Unpreserved (EK071G)							
I1 0.3, I2 0.3,	09-Jun-2024	19-Jun-2024	16-Jun-2024	✗	19-Jun-2024	21-Jun-2024	✓
I3 0.3, I4 0.3,							
I5 0.3, C1 0.3,							
C2 0.3, C3 0.3,							
C4 0.3, C5 0.3,							
C6 0.3							

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP066: Polychlorinated Biphenyls (PCB)								
Soil Glass Jar - Unpreserved (EP066) I1 0.3, I3 0.3, I5 0.3, C2 0.3, C4 0.3, C6 0.3	I2 0.3, I4 0.3, C1 0.3, C3 0.3, C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	19-Jun-2024	25-Jul-2024	✓
EP068A: Organochlorine Pesticides (OC)								
Soil Glass Jar - Unpreserved (EP068) C4 0.3, C6 0.3	C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	17-Jun-2024	25-Jul-2024	✓
Soil Glass Jar - Unpreserved (EP068) I1 0.3, I3 0.3, I5 0.3, C2 0.3,	I2 0.3, I4 0.3, C1 0.3, C3 0.3	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	19-Jun-2024	25-Jul-2024	✓
EP068B: Organophosphorus Pesticides (OP)								
Soil Glass Jar - Unpreserved (EP068) C4 0.3, C6 0.3	C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	17-Jun-2024	25-Jul-2024	✓
Soil Glass Jar - Unpreserved (EP068) I1 0.3, I3 0.3, I5 0.3, C2 0.3,	I2 0.3, I4 0.3, C1 0.3, C3 0.3	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	19-Jun-2024	25-Jul-2024	✓
EP075(SIM)A: Phenolic Compounds								
Soil Glass Jar - Unpreserved (EP075(SIM)) C3 0.3, C5 0.3,	C4 0.3, C6 0.3	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	17-Jun-2024	25-Jul-2024	✓
Soil Glass Jar - Unpreserved (EP075(SIM)) I1 0.3, I3 0.3, I5 0.3, C2 0.3	I2 0.3, I4 0.3, C1 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	19-Jun-2024	25-Jul-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP075(SIM)) C3 0.3, C5 0.3,	C4 0.3, C6 0.3	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	17-Jun-2024	25-Jul-2024	✓
Soil Glass Jar - Unpreserved (EP075(SIM)) I1 0.3, I3 0.3, I5 0.3, C2 0.3	I2 0.3, I4 0.3, C1 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	19-Jun-2024	25-Jul-2024	✓
EP080/071: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP080) I1 0.3, I3 0.3, I5 0.3, C2 0.3, C4 0.3, C6 0.3	I2 0.3, I4 0.3, C1 0.3, C3 0.3, C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	15-Jun-2024	23-Jun-2024	✓
Soil Glass Jar - Unpreserved (EP071) I1 0.3, I3 0.3, I5 0.3, C2 0.3, C4 0.3, C6 0.3	I2 0.3, I4 0.3, C1 0.3, C3 0.3, C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	18-Jun-2024	25-Jul-2024	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP080) I1 0.3, I3 0.3, I5 0.3, C2 0.3, C4 0.3, C6 0.3	I2 0.3, I4 0.3, C1 0.3, C3 0.3, C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	15-Jun-2024	23-Jun-2024	✓
Soil Glass Jar - Unpreserved (EP071) I1 0.3, I3 0.3, I5 0.3, C2 0.3, C4 0.3, C6 0.3	I2 0.3, I4 0.3, C1 0.3, C3 0.3, C5 0.3,	09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	18-Jun-2024	25-Jul-2024	✓

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN								
Soil Glass Jar - Unpreserved (EP080)		09-Jun-2024	15-Jun-2024	23-Jun-2024	✓	15-Jun-2024	23-Jun-2024	✓
I1 0.3,	I2 0.3,							
I3 0.3,	I4 0.3,							
I5 0.3,	C1 0.3,							
C2 0.3,	C3 0.3,							
C4 0.3,	C5 0.3,							
C6 0.3								



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
ASS Field Screening Analysis	EA037	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	3	25	12.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	4	31	12.90	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	25	16.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	3	25	12.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	4	25	16.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	31	6.45	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	4	25	16.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	31	6.45	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	31	6.45	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	25	8.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
ASS Field Screening Analysis	* EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	SOIL	In house: Referenced to APHA 4500-NH ₃ B&G, H Samples are steam distilled prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO ₃ - B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO ₃ - F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NO _x)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NO _x -N) and nitrate (NO ₃ -N) by calculation, Combined oxidised Nitrogen (NO ₂ +NO ₃) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NO _x) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO ₃ - Total Nitrogen is determined as the sum of TKN and Oxidised Nitrogen, each determined separately as N.
Total Phosphorus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.



Analytical Methods	Method	Matrix	Method Descriptions
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	SOIL	In house: Referenced to APHA 4500 P-F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3).
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3).
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM Schedule B(3).
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM Schedule B(3) amended.

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Drying only	EN020D	SOIL	In house
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

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