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REPORT

Marshall Islands Maritime Investment Project

Environment and Social Management Plan

Client: Government of the Republic of Marshall Islands

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Acronyms and Abbreviations

ANZG	Australian & New Zealand Guidelines for Fresh & Marine Water Quality 2018
AtoN	Aid to Navigation
CBOs	Community-based organisations
CIU	Centralised Implementation Unit
COC	Code of Conduct
DGV	Default Guideline Values
DIDA	Department of International Development Assistance
EDSCP	Erosion, Drainage and Sediment Control Plan
EHS	Environmental, Health, and Safety Guidelines
EPA	Environment Protection Agency
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
GoRMI	Government of the Republic of Marshall Islands
GRM	Grievance Redress Mechanism
HT	Human Trafficking
ILO	International Labour Organisation
ISPS	International Ship and Port Facility Security
JSA	Job Safety Analyses
MIMRA	Marshall Island Marine Resources Authority
NEPM	National Environmental Protection Measure
NSW	New South Wales
OC	Organochlorine
OH&S	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PIU	Project Implementation Unit
POMP	Port Operations Management Plan
PPE	Personal Protective Equipment
RHDHV	Royal HaskoningDHV
RMI	Republic of Marshall Islands
RMIMIP	Marshall Islands Maritime Investment Project
SAR	Search and Rescue
SEA/SH	Sexual Exploitation and Abuse and Sexual Harassment
SEP	Stakeholder Engagement Plan

TBT	Tributyltin
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
UXO	Unexploded Ordinance

1 Introduction

1.1 Project background

The Government of the Republic of Marshall Islands (GoRMI), through financing from the World Bank, is undertaking the "*Marshall Islands Maritime Investment Project*" (RMIMIP). The RMIMIP will improve the safety, efficiency and climate resilience of maritime infrastructure and operations in the RMI in compliance with the International Ship and Port Facility Security (ISPS) Code. Refer to Section 2.1 of the Environmental and Social Management Framework (ESMF) (ESIA Consult, 2019), for further discussion of the project rationale and country context.

As part of the requirements of the World Bank, the GoRMI is required to prepare environmental and social safeguard documentation, assessing the potential environmental and social impacts of the detailed designs. The RMIMIP has been identified as a Category B (Moderate Risk) project consistent with World Bank Environmental and Social Safeguard protocols. To fulfil the Category B requirements of the World Bank, the GoRMI has prepared this Environmental and Social Management Plan (ESMP) for the RMIMIP project.

1.2 Environmental and Social Management Plan (ESMP)

This document forms a revised version of the originally developed ESMP, which is an annexure to the ESMF, both of which were developed in 2019 by ESIA Consult. This document contains primary material from version 1 of this ESMP but has been updated to reflect the environmental and social constraints of design works established for the RMIMIP. This document provides detailed site information, with further context and relevant information located in the ESMF. Therefore, this document is to be referred to in addition to the ESMF and is a guide for contractors operating within the RMI under the RMIMIP.

This document provides tailored advice on the following:

- Project description
- Environmental and social baseline
- Legislative context including, but not limited to relevant permits (i.e., earthworks permit)
- Occupational health, safety and management
- Project impacts
- Project mitigation arrangements
- Public consultation

1.3 Key deliverables

The ESMP will include environmental and social elements identified within the GoRMI Terms of Reference (ToR) and discusses their relevance related to the RMIMIP design scope.

Key deliverables include:

- Marine surveys and observations of benthic and marine environments at Arno.
- Marine surveys and observations at locations of new or renovated Aid to Navigation (AtoNs) not already surveyed.
- Further site surveys and field data collection as required to fill site-specific knowledge gaps.
- Preparation of the application to the EPA for earthworks permits.
- Undertake an unexploded ordinance (UXO) risk assessment and provide UXO survey and chance find instructions for the bid documents.

- Screening for potential soil contamination and the requirements for Phase 1 investigations at each dock.

It is important to note, a key component identified within the ToR included the assessment of the proposed design scope against environmental and social constraints, in order to establish the risk category in accordance with the *World Bank Environmental and Social Safeguards Protocol*. Subsequent examination against project scope and design is consistent with the initial identification of a Category B Project (Moderate Risk).

1.4 Sub-project description

The RMIMIP consists of the following four components (refer to Section 4.2 of the ESMF for further information):

- Component 1: Maritime Infrastructure
- Component 2: Maritime Safety and Security
- Component 3: Technical Assistance for Port Planning and Project Management
- Component 4: Contingency Emergency Response

This ESMP is for the following activities:

- Component 2: Maritime Safety and Security
    - Repair quay wall structures, replace quay furniture (fenders, bollards, ladders, kerbs) at Delap, Ebeye, Uliga, Jaluit, Wotje, and Arno Docks.
    - Upgrade/provide fencing, gates, terminal lighting, backup generators, and CCTV systems to comply with ISPS requirements at Ebeye and Uliga Docks.
    - Repair of pavement, removal of scrap and trenching for new utilities at Delap Dock.
    - Construction of a new two-storey blockwork building at Uliga Dock.
    - Construction of a new public toilet outside the Ebeye Dock fenceline.
    - Replace/upgrade Aids to Navigation for Jaluit and Wotje.
    - Backup generators for Delap Dock (50 kVa) and Ebeye Dock.
    - Reinstate dock end, backfill, add new concrete pavement at Wotje Wharf.
    - Perform concrete repairs above and below water at Jaluit Dock.
    - Repair boat ramp, update channel markers, and repair concrete stairs at Arno Wharf.
- Component 3: Technical Assistance for Port Planning and Project Management
    - Prepare designs and supervise maritime infrastructure works.
    - Review institutional and governance arrangements for port management.
    - Prepare strategic development plans, review port operations, including development of security, site safety, efficiency, waste management, and compliance requirements, and maintenance regimes for Delap, Ebeye and Uliga Docks.
    - Capacity building initiatives to better operate and regulate the project docks (search and rescue (SAR) awareness, ISPS training, use of spill kits & booms).
    - Registries Assessment and Options Analysis.
    - Employment opportunities for women.
    - Project management support for Department of International Development Assistance (DIDA) Centralized Implementation Unit (CIU).
    - Incremental operating costs for Project-related travel and communications.

As of now, the environmental team has not been briefed on the specifics of capacity building, institutional arrangements, and governance. Consequently, these aspects have not been addressed in the current ESMP.

The document discusses the scope of works that Royal HaskoningDHV (RHDHV) has designed, pending funding. Due to insufficient funding, the full extent of designed works may not be executed and timeframes could equally be uncertain. If funding streams are identified at a later stage, the scope could be implemented. GoRMI are not committed to all the scope of works happening. This ESMP aims to review environmental and social safeguards on all aspects in the detailed design scope.

Section 8, Stakeholder Consultation, delves into managing uncertainties related to scope implementation.

1.5 Sub-site summary

The proposed works mentioned above would be undertaken on the existing port facilities at:

- Delap, located on Majuro, the main port for marine cargo in RMI;
- Ebeye, the main port for marine cargo on the Kwajalein atoll;
- Uliga, the main port for local vessels in Majuro;
- Jaluit port, classified as an international port under RMI legislation;
- Wotje Wharf; and
- Arno Wharf.

A preliminary summary of works details is provided in the following sub-sections.

1.5.1 Delap

Figure 1-1: Delap works location

Table 1-1: Delap sub-site summary

Delap	Wharf repairs and reinstatement	New pavement, utilities services and lighting
Time on site	• 6 months • Could be accelerated with more staff (i.e., 3 months with 20 staff)	• 12-15 months • Will overlap with the wharf repairs.
Staff on site	• 10	• 6 on site (performing excavation). • 6 truck drivers for spoil carriage. • 6 on site constructing new pavement. • 3 management. • Total 21 workers.
Worker accommodation[1]	• Majuro could accommodate within current boundaries.	• Portable buildings brought to island or use of existing facilities.
Scope	• Breaking away damaged concrete. • Pouring small volumes of fresh concrete near water. • Underwater cleaning of sheet piles and steel welding. • Drilling holes into old concrete to install bolts. • Installing new rubber fenders, bollards, and ladders. • Grading works to level site.	• Excavation of 13500m^3 of waste materials, sent to offsite yard (unconfirmed location in Majuro) for later reuse as aggregate. • Importation of 8000m^3 of aggregate into RMI likely to come in container and transferred to an offsite yard by truck. This aggregate will be batched into concrete. No use of local resources anticipated. • The offsite yard would be used as the concrete batching location. • Concrete trucks would be required to bring the batched concrete to the works site.
Plant[2]	• Small divers' boat, forklift, delivery trucks, small site crane (20 t franna or similar).	• Approx 6 body trucks for earthworks. • Approx 4 concrete trucks. • 3 large excavators. • 2 front end loaders. • Small site crane (20 t franna or similar). • Miscellaneous delivery trucks from local suppliers. • Assuming 40 trucks/day could go to and from the site, traffic could last 170 days[2].
Materials[3]	• Concrete products. • Steel plate • Fenders, bollards and ladders, miscellaneous materials. • Small number of truck movements required.	• The materials will be unloaded onto Delap Dock, containerised, and moved to an offsite yard via trucks. This yard will also serve as the concrete batching location, while small amounts of concrete being batched on site. • 8000 m^3 imported aggregate • 13,500 m^3 excavated material (for reuse as aggregate) • Lights

[1] *The availability of housing is further discussed in Section 5.2.1.1.*
[2] *Traffic management is further discussed in Section 5.4.*
[3] *Waste management is further discussed in Section 5.3.*

1.5.2 Ebeye

Figure 1-2: Ebeye works location

Table 1-2: Ebeye sub-site summary

Ebeye	
Time on site	• 6 months • Could be accelerated with more staff (i.e., 3 months with 20 staff).
Staff on site	• 10
Worker accommodation	• Local Accommodation options such as Hotel Ebeye are sufficient for this number of workers.
Scope	• New light posts. • Extensive repair concrete capping beam (above and below water). • Repair/replace concrete kerbs. • New safety ladders. • New cathodic protection to sheet piles. • New fence and gate. • New fenders and chains (cone fenders). • New bollards and cleats (remove existing). • New backup generators. • New public toilet block. • Sheet pile strengthening work (underwater works). • Repair gap in sheet pile wall structures (underwater works).
Plant	• Small divers' boat, forklift, delivery trucks, small site crane (20 t franna or similar). • Concrete batched on site.

Ebeye	
Materials	• Materials will be delivered directly to Ebeye Dock via ship and all materials will be kept on site once delivered. • Concrete products (500 m^3 batched on site). • Demolished concrete waste which will be stockpiled within the port facility for future use. • Steel plate and sections. • Fencing, fenders and bollards. • Small number of truck movements required. • Anodes.

1.5.3 Uliga

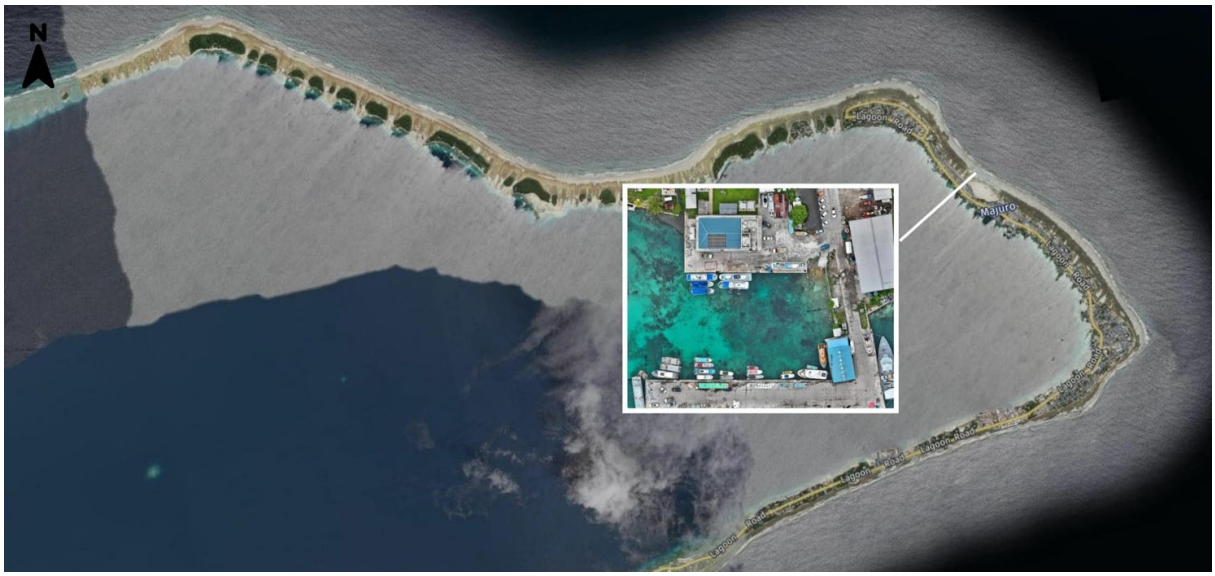

Figure 1-3: Uliga works location

Table 1-3: Uliga sub-site summary

Uliga	
Time on site	• 5 months
Staff on site	• 10
Worker accommodation	• Majuro could accommodate these within current facilities.
Scope	• Two new pontoons at inner berth. • New dock hoist for pilot boats (occurring external to RHDHV design scope). • Replacement of fenders. • Replacement or mooring rings with cleats and repaint of existing bollards. • Addition of new cleats. • New lighting. • Installation of traffic barriers and bollards. • Replace anodes to cathodic protection system. • Various concrete repairs (above and below water). • Repairs to kerb, and concrete trench covers. • Repairs to electrical shore power cabinet and fuel trench covers. • Installation of new safety ladders. • New two-storey blockwork building. • Backup generators.
Plant	• Small divers' boat, forklift, delivery trucks, small site crane (20 t franna or similar). • Only a small amount of truck movements is required.
Materials	• The materials will be unloaded onto Delap Dock, containerised, and moved to Uliga dock via trucks.

Uliga	
	• Excavation will be minimal and small amounts of concrete will be batched on site. • Concrete products. • Steel plate and sections. • Fencing, fenders and bollards. • Pontoons and aluminum gangways (proprietary). • Small number of truck movements required. • Anodes.

1.5.4 Jaluit

Figure 1-4: Jaluit works location

Table 1-4: Jaluit sub-site summary

Jaluit	Dock Repairs	AtoN Installation
Time on site	• 4 months	• 2 weeks in each location x 7 locations
Staff on site	• 10	• 8
Worker accommodation	• Portable buildings brought to island. • Alternatively, vessels with onboard accommodation would be brought to the island.	• Barge/vessel
Scope	• Replacement of fenders and addition of new fenders. • Repainting of bollards. • New lighting. • Repairs to sheet pile wall (welding of steel plates under water). • Painting of sheet piles above the water level. • Installation of safety ladders, • Installation of cathodic protection system to sheet pile wall. • Various concrete repairs (above and below water). • Pavement repairs.	• These are in isolated locations with no wharfs. • A large excavator (~40 t size) needs to get onto land from a barge/vessel. • This will require placing a rock fill ramp over the coral so the excavator can track off the barge, onto the ramp, and up onto the beach. • Then the excavator will dig a hole in the beach/coral slope. A reinforced concrete foundation will be constructed inside the excavation and then the area around it will be backfilled. • The excavation would disturb a max 5m x 5m area but the movement of the excavator to

Jaluit	Dock Repairs	AtoN Installation
		each location could cause additional damage to coral.
Plant	• Large excavator • Large loader • 2 or 3 trucks • No accommodation on island, so portable temporary buildings brought to use.	• Barge/vessel • Large excavator
Materials	• Materials will be delivered to either Delap dock or Ebeye Dock, and then transferred to smaller vessels for transport to site. All materials will be kept on site once delivered. • The 500 m^3 of concrete that needs be batched will be done on site. • Concrete products. • Demolished concrete waste which will be stockpiled within the port facility for future use. • Steel plate. • Paint. • Fenders. • Anodes.	• Concrete products. • Steel poles.

1.5.5 Wotje

Figure 1-5: Wotje works location

Table 1-5: Wotje sub-site summary

Wotje	Dock and Ramp Repairs	AtoN Installation
Time on site	• 6 months	• 2 weeks in each location x 7 locations
Staff on site	• 15	• 8
Worker accommodation	• Portable buildings brought to island. • Alternatively, vessels with onboard accommodation would be brought to the island.	• Barge/vessel

Wotje	Dock and Ramp Repairs	AtoN Installation
Scope	• Reinstatement of end of dock. • Clearance of debris (some will require hydraulic impact breaking), and excavation for placement of rock bedding. The installation of concrete blocks and rock infill on top of seabed will then be added (i.e., aggregate materials). • Repairs of existing concrete retaining walls (above and below water) and reinstatement of backfill. • New concrete pavement at the dock and concrete pavement repairs at the ramp. • New fenders. • New bollards. • New lighting.	• These are in isolated locations with no wharfs. • A large excavator (~40t size) needs to get onto land from a barge/vessel. • This will require placing a rock fill ramp over the coral so the excavator can track off the barge, onto the ramp, and up onto the beach. • Then the excavator will dig a hole in the beach/coral slope. A reinforced concrete foundation will be constructed inside the excavation and then the area around it will be backfilled. • The excavation would disturb a max 5 m x 5m area but the movement of the excavator to each location could cause additional damage to coral.
Plant	• Plant and materials will be delivered by a vessel with a ramp to the Wotje Ramp, where trucks/excavators will drive off the vessel onto the ramp. • Large excavator • Large loader • 2 or 3 trucks • No accommodation on island, so portable temporary buildings brought to use.	• Barge/vessel • Large excavator
Materials	• Materials will be delivered to either Delap dock or Ebeye Dock, and then transferred to smaller vessels for transport to site. • Concrete products (200 m^3 batched on site). • All materials will be kept on site once delivered. • Concrete that is removed at Wotje will be reused as backfill for works at the dock end. • All spoil generated can be reused in the works. • Import new precast blocks onto island using a delivery vessel at high tide which will not require dredging/seabed disturbance. • Backfill imported. • Bollards and fenders.	• Concrete products. • Steel poles.

1.5.6 Arno

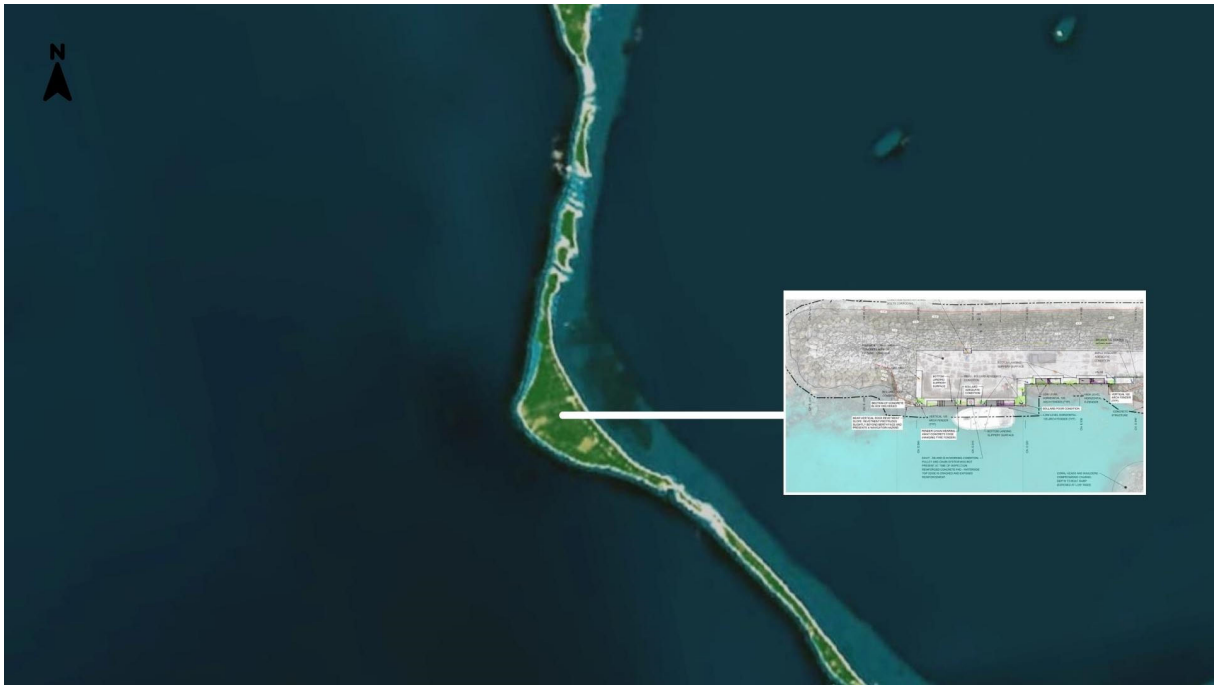

Figure 1-6: Arno works location

Table 1-6: Arno sub-site summary

Arno	
Time on site	• 6 months
Staff on site	• 8
Worker accommodation	• Portable buildings brought to island. • Alternatively, vessels with onboard accommodation would be brought to the island.
Scope	• Overlay of dock surface. • Replacement of fenders. • Replacement of bollards. • New lighting. • New AtoN • Repairs to concrete stairs.
Plant	• Large excavator. • Large loader. • 2 or 3 trucks. • No accommodation on island, so portable temporary buildings brought to use.
Materials	• Materials will be delivered to either Delap dock or Ebeye Dock, and then transferred to smaller vessels for transport to site. All materials will be kept on site once delivered. • Concrete products (800 m^3 batched on site). • All concrete waste can be added to the rock revetment near the dock. • Fenders and bollards. • Small number of truck movements required (utilising temporary ramp for barges and landing craft).

2 Environmental and Social Baseline

2.1 Introduction

A detailed environmental and social baseline background is provided in the RMIMIP ESMF, with a succinct summary provided below in order to support this ESMP document. The baseline information included in the ESMF has not been repeated below. Any additional site-specific baseline information not incorporated within the ESMF is also presented below.

Since the development of the ESMF, the following studies have been completed, and key outcomes have been presented below.

- Benthic assessment in November 2023 only for Jaluit, Wotje and Arno (full report available at **Appendix A1**).
- Water quality and sediment quality testing at Delap and Arno ports in July 2023 (results summary available at **Appendix A1**).
- Soil contamination testing at Delap and Arno ports in July 2023 (results summary available at **Appendix A1**).

2.2 Delap

Delap operates as the primary International Dock for shipping in RMI's largest Atoll, Majuro. The dock contains a cargo handling area, equipment repair shop, container freight station and RMIPA administrative offices, all of which support the processing and storage of containers and general cargo. Delap is on the leeward, southern lagoon shore of the large island of Majuro atoll. It is the main port for marine trade in the RMI. Delap has a wharf length of 308 m and an apron width of 30 m. The berth pocket is dredged to 17 m. The container yard, which has a base of crushed coral, sits immediately adjacent to the wharf, and includes several power connections for reefers. The yard has an area of 6.398 acres (25,891 m^2).

Majuro is home to over half of the country's population, with Delap containing highly crowded households, averaging 8.6 persons. The island has a very low labour force (43%), with some attributing limited employment opportunities to increases in alcohol abuse, theft, and pollution. In recent years, the Delap port has undergone a condition assessment, which highlighted critical improvements necessary for the ongoing service it provides to the local and National community. The dock has been highlighted for refurbishment, with critical dock stabilisation, kerb and walkway repairs, and upgrades to lighting, bollards, and mooring lines also required.

Terrestrial biodiversity is limited in the immediate region, with many areas highly urbanised. The benthic habitat is predominately macro-abiotic at the main operational area (the northern facing dock), consisting mostly of coarse sand, bare rubble, and litter/refuse, with sparse visible epiflora or fauna. This area rapidly changes to deep lagoon habitat to the north via a sandy slope. The area immediately to the east of the port dock is also an operationally busy area with a shallow lagoon benthic habitat: abundant macroalgae (≈30% cover), sparse individual hard coral colonies, and coarse sand. To the west of the port the benthic habitat transitions from a deeper lagoon environment to a fringing reef flat environment, although mostly consisting of algal turf covered hard substrate with sparse hard coral cover.

Recent additional studies were conducted to further develop the baseline understanding.

Water quality testing: The results have been compared to the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG) 2018[4] which provides toxicant default guideline values (DGVs) for sediment. The water quality analysis shows all sediment samples from Delap Port had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested except copper.

Sediment quality testing: The representative sample from Delap Port comprised a gravelly sand with only 5% fines. The sediment samples from Delap Port had low concentrations of the majority of heavy metals, polycyclic aromatic hydrocarbons (PAHS), polychlorinated biphenyls (PCBs) and organochlorine (OC) pesticides either below laboratory detection or below the DGVs. However, some samples had elevated concentrations of antimony, lead, zinc, total petroleum hydrocarbons (TPHs) and tributyltin (TBT) above the DGVs and one sample exceeded the ANZG High Guideline Value (GL-High) for zinc indicating there may be some risk of impacts to aquatic ecosystem due to disturbance of these sediments.

Soil contamination testing: Soil samples taken from test pits indicate the soil is a fine to coarse gravelly sand derived from coral. The soil samples from Delap had low concentrations of the majority of heavy metals, PAHs, BTEX (group of volatile organic compounds benzene, toluene, ethylbenzene, and xylenes), TPH and pesticides either below laboratory detection or below the assessment criteria. Contaminants detected above the laboratory detection limits were primarily observed in the samples at 0.1 m depth. The results showed all samples did not exceed the adopted contaminant threshold 1 (CT1) waste criteria, indicating these samples can be classified as General Solid Waste (non-putrescible). Asbestos was not identified in any sample collected, indicating the soil assessed is not a special waste (i.e., when using the Environmental Protection Agency (EPA) of New South Wales (NSW) Waste Classification guideline definition).

2.3 Ebeye

Ebeye is the main port for marine cargo on the Kwajalein Atoll. The port is situated on the leeward, lagoon shore of Ebeye Island on the southern corner of Kwajalein Atoll. It is 5.5 km from the US military port of Kwajalein and 442 km from the Port of Majuro. It supports both inter-island ferry services and international and inter-island container and general cargo trades, including fuel. The wharf has a length of 120 m (400 feet) with a width of 36.5 m (120 feet). Water depth around the main operational area, to the western side of the wharf, varies from around 12 m to 17 m, before deepening to the west.

Majuro is home to over 10,000 people, with unemployment estimated to be as high as 38 percent. Ebeye, like most developing nations, has significant issues with the availability of power, water, high cost of living, overpopulation, and sanitation facilities. The port runs free services funded by the US Army, but lacks the amenities needed to facilitate improved service offering's (i.e., no reach stacker). In recent years, the Ebeye port has undergone a condition assessment, which highlighted amenity, and safety improvements necessary for the ongoing service it provides to the local and National community. The dock has been highlighted for upgrades to lighting, bollards, toilet facilities and mooring lines.

Ebeye is highly urbanised and the area around the port is no exception. Some of the nearest buildings to the port are the Payless Triple J supermarket, the Hotel Ebeye and the Little Mermaid Chinese restaurant. All three business are approximately 150 m from the front face of the wharf. It is less than 400 m from the dock face to the lagoon side of the island and that distance is heavily urbanised.

Terrestrial biodiversity is again limited due to high urbanisation. The existing benthic habitat at the main operational area and to the north of Ebeye port predominately consists of both macroalgae

[4] *RMI does not have its own guidelines so we have used the Australian guidelines as they are internationally accepted.*

(*Halimdea* sp. meadows) and macro-abiotic substrate (mostly coarse sand, bare rubble, and litter/refuse) with sparse visible epifauna. The area immediate south and SSE of the port is a shallow lagoon area abutting the western shore of Ebeye Island. The shallow lagoon area is where the substrate transitions to higher algal turf cover and there is also sparse hard coral cover of ≈<5%.

Recent additional studies were conducted to further develop the baseline understanding.

Soil contamination testing: The soil samples from Ebeye had low concentrations of the majority of heavy metals, PAHs, BTEX and TPH pesticides either below laboratory detection or below the assessment criteria. Contaminants detected above the laboratory detection limits were primarily observed in the samples at 0.1 m depth. No contaminants were reported above the adopted human health assessment criteria at locations sampled. Minor detections of select TPH fractions, heavy metals and PAHs were reported, however, not at concentrations likely to impact reuse of the soil. The results showed all samples did not exceed the adopted contaminant threshold 1 (CT1) waste criteria, indicating these samples can be classified as General Solid Waste (non-putrescible). Asbestos was not identified in any sample collected, indicating that the soil assessed is not classified as special waste under the EPA NSW Waste Classification guideline definition.

2.4 Uliga

The Uliga Dock is used for the moorage of governmental vessels owned and operated by the RMI Marshall Island Marine Resources Authority (MIMRA), the RMI Ministry of Transportation and Communications and the RMI Ports Authority (RMIPA). Uliga is the main port for local vessels in Majuro. Uliga port is situated on the leeward eastern lagoon shore of the large island on the eastern corner of Majuro atoll. Uliga Port has four berths, with a wharf length of 120 m and has an apron width of 15 m, which is the width of the whole dock. The berth pocket is dredged to between 9 m. The main wharf, which is L shaped serves local vessels, tenders for fishing vessels while the inside of the L serves as a marina for private and smaller commercial domestic vessels.

In recent years, the Uliga port has undergone a conditions assessment which highlighted amenity and safety improvements necessary for the ongoing service it provides to the local and National community. The dock has been highlighted for upgrades to lighting, bollards, mooring, underwater and above ground concrete repairs, and the development of a two-story dock building,

The area around the port is heavily urbanised and as a result has low terrestrial biodiversity. Immediately behind northwest of the port is the MIMRA Outer Islands Fish Market Center, adjacent to this is the Uliga Inn which could potentially be used by fishers. A new multi-story commercial building is being built adjacent to Uliga port. Approximately 150 m to the northwest of the port is the Cost Price Supermarket and across the main Majuro Road is the Adele Museum and Public Library (approximately 220 m NW of the wharf).

The benthic habitat around the north and west of the dock is predominately a mix of macroalgae beds on coarse sands with large sandy spaces and sparse visible epiflora or fauna, transitioning via a steep slope to deep lagoon habitat to the west. To the east of the dock, in-between the dock and land, the benthic environment consists of a small reef among coarse sand. To the south of the dock, the habitat transitions from deep lagoon to shallow lagoon abutting fringing reef slope and flat to the island shore. The shallow lagoon here is predominately biotic habitat consisting mostly of macroalgae and algal turf on hard substrate, with some in between coarse sand and sparse individual hard coral colonies. The reef slope to the south-east has relatively high coral cover in a small area (≈35% cover) and abundant algal turf on hard substrate.

2.5 Jaluit

The port at Jaluit is situated on the leeward, lagoon shore on the southern corner of Jaluit Atoll. The port has one single berth for a ship and a roll on roll off facility on the northern side, the structure is approximately 33 m long by 10 m wide. A single lane road provides access from the wharf to the nearby village. The nearest urban development is approximately 75 m from the front face of the wharf.

Jaluit contains one of the highest unemployment rates at >50% and, as such, many inhabitants of the 20 islands within this atoll engage in subsistence living. The reduction in income has led to an increase in (over)fishing, increased conversion of native habitat to food producing areas, and increases in localised crime.

The seabed substrate associated with the existing Jaluit dock is relatively homogenous and is characterised by a bottom layer of coarse sand, gravel and rocks derived from coral reef origins. The benthic substrate directly associated with the existing dock has been significantly altered and reclaimed for the construction of the dock. Adjacent coastal foreshore, beach, intertidal and upper subtidal reef flat have been significantly altered resulting in degradation of the benthic ecosystem habitat and function. Significant garbage (e.g., machinery, equipment) was located on the seafloor near the dock.

Surrounding the port, the benthic habitat is predominately macro-abiotic, consisting mostly of coarse sand with sparse visible epiflora or fauna. Isolated branching colonies (Acropora sp.) were located within the subtidal reef flat to the south of the existing dock. These small, isolated colonies were rare and possessed the highest coral coverage within the area assessed. Newly recruited hard coral colonies were located in very low numbers providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers reflecting past anthropogenic impacts to the marine benthic habit and resources. Finfish population numbers and species diversity was very low. Species that were present were juveniles and include reef dwelling plankitvores (small fish), herbivores (e.g., Acanthuridae, Scaridae), corallivores (e.g. Chaetodondae) and there was a noticeable lack of predator reef fish.

There are no protected areas within or in close proximity to the Jaluit dock. However, a Type II designated nearshore marine and terrestrial area is located approximately 850 m to the north of the dock. This designated protected area is well outside the direct and in directed areas of influence of the project and therefore none of the works are likely to adversely impact the protected habitats.

2.6 Wotje

The Wotje Port is a single channel port located immediately adjacent to the township, with a total land area of 8.18 square kilometers and an enclosed lagoon of 624 square kilometers. Small dirt roads connect local inhabitants with the local airport, dock, and high school. The GoRMI operates and owns one transport ship, that facilitates trade and transport between communities. Wotje's dock facilities consist of a concrete, earth filled finger wharf. The dock extends approximately 200 m into the lagoon. There is a small boat landing area on the southern side of the dock. Large vessels are unable to directly use the dock. Approximately 500 m to the north is a concrete ramp on which Marshall Energy Company (MEC) has an oil transfer connection.

The dock was extensively damaged by bombing during the WWII and debris is scattered in the water around the outer end of the dock. A coral habitat has formed within this debris. Isolated hard coral colonies were recorded attached to (1) elevated hard substrates within the subtidal rock patches either side of the Wotje Dock, (2) within the sand sea floor adjacent to the dock and/or (3) to a much lower percentage attached to the dock wall.

The presence of coral reefs is fragmented, with submerged wrecks, and concrete rubble containing various degrees of biodiversity. There is limited terrestrial biodiversity, with many regions highly urbanised around the port area. No soft corals were recorded. Hard coral small sub massive (e.g. Porities sp.), digitate (Porities sp.) and branching (e.g. Pocillopora sp.) morphological forms dominated.

Wotje is home to over 800 people, with unemployment estimated to be on average > 38 percent. The community experiences significant issues with availability of power, water, high cost of living, overpopulation, and sanitation facilities, but recently a growing number of drug and alcohol related impacts are increasing safety concerns for residents. Improving local amenities and providing critical improvements is necessary. The dock has been highlighted for significant upgrades, to kerbs, lighting, port facilities. In addition, the upgrades include the removal of historical rubble, which is currently preventing use by larger boating vessels.

The sandy beaches alongside both wharves shelve out gently, so water depths at the end of the wharves is not significant. There is rubble alongside and at the ends of the wharves, but otherwise the immediate habitat consists of mostly sandy substrate. The shorelines in the area consist of sandy beaches, fringed by coconut palms. Urban development is mostly set back behind the trees.

The seabed substrate associated with the existing Wotje Dock is relatively homogenous and characterised by a bottom layer of coarse sand, gravel and rocks derived from coral reef origins. The benthic substrate directly associated with the existing dock has been significantly altered and reclaimed for the construction of the dock. Adjacent coastal foreshore, beach, intertidal and upper subtidal reef flat and lagoon have not been altered and as such remain functioning as a natural benthic ecosystem.

The benthic substrate directly associated with the existing ramp has been significantly altered and reclaimed for the construction of the ramp. Adjacent coastal foreshore, beach and intertidal and subtidal reef flat and lagoon have not been altered and as such remain functioning as a natural benthic ecosystem.

Macroalgae (Padina sp., Dictyota sp., and Laurencia sp.,) percent coverage ranged between 10-80% with areas located on both sides of the Wotje dock within the subtidal zone associated with the rubble bed possessing the highest percentage coverage (60-80%). In addition, blue green algae percent coverage range between 10-30% associated with the subtidal and lagoon sand seafloor. Isolated small individuals colonies (patches) of sea grass (Enhalus acoroides) were recorded within the subtidal and lagoon proper on both sides of the Wotje dock. Colonies were small (less than 1 m^2) and density throughout the area was very low and sporadic.

Finfish population numbers and species diversity was very low. Species that were present were juveniles and include reef dwelling plankitvores (small fish) and herbivores (e.g. Acanthuridae, Scaridae) and there was a noticeable lack of predator reef fish. The marine benthic environment associated with the dock contains anthropogenic community derived garbage.

None of the protected areas are within or in close proximity to the Wotje dock or ramp, with the closest protected area designation over 7.7 km to the west. Designated protected areas are well outside the direct and in directed areas of influence of the project and as such will have no impacts from the project's scope of works.

2.7 Arno

Arno Atoll has the greatest number of inhabited islands and has the third largest population among all jurisdictions in the RMI. Small cargo boats sail between Majuro and Arno. Arno has a dock on the south-western end of the island of Arno. The dock is approximately 75 m long. It has a concrete top

and stairs on the eastern side providing access to water level. At the landward end of the dock there is a building approximately 12 m x 15 m. Vessels utilise the eastern side of the wharf where the water is deepest.

Recent additional studies were conducted to further develop the baseline understanding.

Water quality testing: The water quality analysis shows that all sediment samples from Arno Dock had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested except copper.

Sediment quality testing: The results show that all sediment samples from Arno Dock had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested indicating a low risk of impacts to the aquatic ecosystem due to disturbance of these sediments.

Benthic assessment: The presence of an extremely rare species of coral (an archetypal elkhorn) has been reported close to the dock (Richards, Wallace, & Miller, 2010). This reef site is adjacent to the existing Arno dock, however the reported site is at a minimum 100 m from the dock. During the benthic assessment undertaken in 2023, the rare hard coral Acropora palmata (Pacific Elkhorn) was not recorded within the waters directly or indirectly associated with the Arno dock.

Past reclamation activities including the construction of the docks has significantly degraded water quality (e.g., high siltation levels, reduction of benthic habitat) and hard coral communities in close proximity to this site are negatively impacted including hard coral colony mortality. Arno dock site possessed high levels of suspended sediment and poor water clarity in and around the dock, especially the southern site (dredged site). The siltation associated with the Arno dock site has been discharge onto the outer reef systems adjacent to the dock causing significant hard coral mortality.

A large number of hard coral colonies located on or in close proximity on the southern side of the Arno dock recorded signs of stress due to high levels of suspended sediments, with significant hard coral mortality recorded throughout the area. There was a notable absence of large coral heads, table corals of any size and sea anemones at all sites assessed. There were no soft coral colonies and/or individuals located within these zones. There was no evidence of hard coral disease (e.g., bacteria or virus), the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.*

The intertidal reef flat directly south of the Arno dock has been physically removed due to past dredged operations, resulting in an area of approximately 3,000 m^2 extending the full length of the dock (**Figure 2-1**). The dredged area has an average depth of 3 m, vertical dredged walls and allows water access to the Arno ramp located directly south of the dock. The benthic report indicates that the dredged material was used to construct the dock, ramp and associated foreshore reclamation activities. This benthic substrate throughout the dredged area is devoid of benthic sessile biotic resources. Hard coral and macroalgae were recorded on the vertical walls and on substrate not physically altered due to the past dredging activities.

Figure 2-1: Location of dredged area associated with the Arno Dock

None of the protected areas are within or in close proximity to the Arno dock. However, Type I designated nearshore marine and terrestrial area is located approximately 500 m to the north of the dock. A type II designated lagoon marine area is located approximately 800 m to the north of the dock, this area is within the lagoon. The designated protected areas are well outside the direct and in directed areas of influence of the project with the type II designated site within the lagoon and as such will have no impacts from the projects scope of works.

3 Legal and Other Requirements

Detailed discussion surrounding legal and other requirements has already been covered in the ESMF document. Section 5 of the ESMF contains a detailed list of legislation (State, Commonwealth, environmental and heritage legislation), policies and agreements that are relevant to environmental and social safeguards in the RMI and for the RMIMIP.

All works will be undertaken in accordance with relevant legislation, regulations, and with respect to World Bank Groups Environmental and Social Safeguard Policies. The development of project permits such as the Earthworks Permits are to be undertaken in accordance with relevant legislation and subsequent regulation.

4 Health, Safety and Management

4.1 Occupational Health and Safety (OH&S)

In the absence of local legislation, OH&S under this project will be regulated through the World Bank Group's Environmental, Health, and Safety Guidelines. Refer to the ESMF Section 5.

4.2 Environmental and Social Management Roles and Responsibilities

Sections 8 and 11 of the ESMF discuss environmental and social management roles and responsibilities in detail. See the summary below for a brief description of role and responsibilities in ensuring environment and social safeguards on the RMIMIP. Environmental and social management capacity building (training) will be required.

Position	Responsibilities
General Manager and HSEQ General Manager	• Approve exemptions in accordance with this document. • Set high compliance standards.
Project and Operations Manager	• Ensure all Contractors receive a copy of this document. • Set high compliance standards. • Ensure educational and pertinent compliance material is readily available. • Regularly verify risk controls are implemented.
Project and Operations Health, Safety and Environment Manager	• Champion requirements of this document to ensure site implementation. • Provide assurance support and oversight. • Be the subject matter expert to support contractors and supervisors.
Utilities Health, Safety and Environment Operations Manager	• Document Owner. • Maintain document to ensure most recent RMI, World Bank requirements are included. • Communicate changes to Project and Operational Personnel.
Project and Operations Supervisor	• Positively reinforce the requirements of this document. • Verify controls are in place. • Provide training as required to meet regulatory and approval requirements and in accordance with personnel commencement.
Contractors	• Understand the hazards. • Follow the rules and implement the controls identified in this document. • Speak up if controls are not in place and stop the job. • Get involved in identifying opportunities for improvement.

5 Potential Environmental and Social Impacts and Risks

The RMIMIP will undertake activities across five atolls (seven wharves) in RMI. The activities will be undertaken in locations that are already disturbed. The environmental and social impacts envisaged for the RMIMIP are predominantly temporary in nature and are associated with construction and upgrading activities.

5.1 Local Community and Workers

5.1.1 Community Health and Safety

The potential risks to community health and safety are associated with the project's construction phase and would mainly comprise influx of labour, minor dust and noise impacts and pedestrian/traffic hazards.

Materials will be required to be imported. The additional shipping movements represent potential for illegal movement of people (e.g., human trafficking (HT) and/or the contribution to prostitution, harassment, and violence).

5.1.1.1 Influx of Labour

The works proposed will result in a significant influx of workers: with a potential 30 at Delap Port; 10 at Ebeye, Uliga and Jaluit; 15 at Wotje; and 8 each for Arno and AtoN installation at Jaluit and Wotje.

The temporary introduction of foreign workers to the remote island communities for the construction period can result in social impacts. While the influx of this labour can have positive effects (e.g., increased opportunity for capacity building and economic development), often labour influx results in or contributes to adverse social impacts.

If not planned for and effectively managed, labour influx can impact on the following social areas:

- **Risk of social conflict:** Conflicts may arise between the local community and the construction workers, which may be related to religious, cultural, or ethnic differences, or based on competition for resources. Tensions may also arise between different groups within the labour force, and preexisting conflicts in the local community may be exacerbated. Alcohol and drugs can add to the issues from either group. All Contracting staff (local and international) will be subject to an individual code of conduct (COC) which must cover behaviours and consequences of poor decisions.
- **Impacts on community dynamics:** Depending on the number of incoming workers and their engagement with the communities, the composition of the local community, and with it the community dynamics, may change significantly. Pre-existing social conflicts may intensify as a result of such changes including domestic violence issues.
- **Local inflation of prices:** A significant increase in demand for goods and services due to labour influx may lead to local price hikes and/or crowding out of local residents.
- **Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH):** The increased income and positions of perceived increased power of men employed for the project may lure women and even children into exploitative situations. They can be more readily sexually exploited and there may also be an increase in demand for sex workers.
- **Harm to children:** The increased number of foreign workers with more disposable income than readily available on the island can provide a sad bargaining chip for some poor families to exploit their children. Children can also be lured by unscrupulous persons with the promise of something enjoyable. Subsequently there are numerous cases across the Pacific of children being sexually exploited.

- **Increased risk of communicable diseases:** The influx of foreign contracting workers can create an increased risk of HIV/AIDS and other STIs. Workers may bring communicable diseases to the project area, including STDs. This can result in an outbreak of the infectious disease in a remote and unprepared island setting which would ultimately lead to significant health outcomes and even deaths. For other communicable diseases, they would create an additional burden on local health resources which would be a significant burden in an island setting. There are only two hospitals on RMI (in Ebeye and Majuro), and this already relies on workers from other Pacific Island countries to staff and cater for existing residents.

5.1.1.2 Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH)

The influx of foreign labour, as well as local workers having higher disposable incomes, creates an increased risk for HIV/AIDS, HT and/or SEA/SH. In line with the World Bank's revised the Good Practice Note 'Addressing SEA/SH in Investment Project Financing Involving Major Civil Works', SEA/SH by project workers are the types of SEA/SH most likely to occur in or be exacerbated by projects like this.

5.1.1.3 Child Protection and Safety

Traffic Safety: There are limited recreational opportunities for children on the island and children spend a lot of time, particularly during the night, outside looking for things to do. All work sites will be tempting for children to play on and that presents a significant safety risk. Given the crowded conditions on the island, the roads are used not only for car transport but also for walking and as children's playground. The high estimated number of deliveries as described in **Section 5.4** along the road can lead to serious injury or worse, if road rules are not observed by drivers and pedestrians and if the risks aren't fully appreciated by all parties. Usual haulage management approaches used on projects of this scale (such as night haulage) don't necessarily minimise the risk in the RMI context due to the high number of pedestrians, particularly children, on the street at night. Project traffic overall will provide one of the most challenging construction phases risks to manage.

5.1.2 Occupational Health and Safety

There are OH&S hazards associated with construction work. Works over and around water increase hazards and construction methods, safety plans and training need to take this into consideration. The nature and duration of the works are such that OH&S risks can be managed with good industry practices so that risks are minimised.

Asbestos Containing Material
No asbestos containing material is anticipated to be encountered during the activities covered by this ESMP, although it is likely that such material exists within some of the port facilities.

5.2 Community Services and Infrastructure

5.2.1.1 Availability of Housing

Accommodation is limited on the islands for project durations of 6-15 months. Majuro has two large hotels, but availability may be limited during concurrent projects or conferences. In Ebeye, local accommodation options such as Hotel Ebeye are likely sufficient for the proposed numbers of workers. Other port locations have just one hotel with a few apartments for rent. Therefore, the Contractor must provide accommodation for most staff, with Project Managers or specialists possibly using local lodging on a 'Fly in Fly Out' basis.

Majuro can host workers for the 6-month wharf repairs at Delap Dock and Uliga. Portable buildings are required for the 12–15-month pavement works project at Delap Dock. Similar structures may be necessary for Jaluit, Wotje, and Arno (depending on the number of international workers). Alternatively at Jaluit, Wotje and Arno, vessels with onboard accommodation would be brought to the

island. For the workers installing AtoN at Jaluit and Wotje, they will be accommodated on a barge or ship.

Land leases are with the client and the status is as described in **Table 5-1**.

Table 5-1: Land lease status

Lease Location	Status	Responsibility
Delap	Completed - current lease ending December 31, 2030	-
Ebeye	Completed - current lease ending June 30, 2041.	-
Uliga	Pending – RMIPA is working on a lease extension (expired in 2019)	RMIPA
Jaluit	Pending - draft lease available; To Do: 1) Lands & Survey form to be given to Mayor and get formal landowner signatures for proposed lease area. 2) Receive fully signed form and submit to Division of Lands & Survey at Public Works. 3) Lands & survey scheduling (transportation & per diems) all cost under MIMIP. 4) Receive Lands & Survey Certification.	RMIPA/ MIMIP
Wotje	Pending - draft lease available; To Do: 1) Lands & Survey form to be given to Mayor and get formal landowner signatures for proposed lease area. 2) Receive fully signed form and submit to Division of Lands & Survey at Public Works. 3) Lands & survey scheduling (transportation & per diems) all cost under MIMIP. 4) Receive Lands & Survey Certification.	RMIPA/ MIMIP
Arno	Pending - draft renewal lease available; To Do: 1) Lands & Survey form to be given to Mayor and get formal landowner signatures for proposed lease area. 2) Receive fully signed form and submit to Division of Lands & Survey at Public Works. 3) Lands & survey scheduling (transportation & per diems) all cost under MIMIP. 4) Receive Lands & Survey Certification.	RMIPA/ MIMIP

5.2.1.2 Food Supplies

Whilst Majuro doesn't have major challenges associated with the supply of food, the other islands do and this needs to be taken into account when supply food to workers. Agriculture and fishery activities on the islands (excluding Majuro) are at a subsistence level rather than commercial, therefore there isn't expected to be enough food grown or caught locally to support additional demands from the workers and there is insufficient food stock to cope with additional demands from foreign workers.

Worker Use

With the influx of labour onto the islands for the period of construction, there will be an increased demand for freshwater. It is estimated that the average person requires 100 litres of water per day. It has been proposed that the Project can utilise the local water supply and this is expected to be sufficient for the number of workers at each dock site, but this would need to be verified prior to commencement of works based on the final number of workers needed. Cumulative projects such as the Ebeye Seawall project, will challenge these availabilities. Any additional pressure would leave the community water supply vulnerable to disruption of supply or shortages. As such, the contractor may need to provide their own potable water supply for workers during construction.

Construction Use
For construction water, the small volumes of concrete that will be batched for repair works should be feasible within the local freshwater supply at all locations except Delap Dock.

The freshwater consumption for construction at the other docks are expected to be minimal and as follows:

- Ebeye Dock ~ 500 m^3 = 0.0875 ML total = 8750 L/day[5] for 10 days
- Uliga Dock ~ 100 m^3 = 0.0175ML total = 8750 L/day[5] for 2 days
- Jaluit Dock ~ 500 m^3 = 0.0875 ML total = 8750 L/day[5] for 10 days
- Wotje Dock ~ 200 m^3 = 0.035 ML total = 8750 L/day[5] for 4 days
- Arno Dock ~ 800 m^3 = 0.14 ML total = 8750 L/day[5] for 16 days

Delap Dock: In the case of the new pavement at the Delap Dock, it is expected that 8,000 m^3 of concrete will be batched, requiring about 1.4ML of water to produce. This water must be fresh. It is assumed that daily 50 m^3 of concrete would be batched for 4 days/week (approximately 5.5 months). Therefore, on average 8750 L/day of water is required to produce insitu concrete for the new pavement works at Delap Dock.

5.2.1.3 Wastewater Generation

The main potential impacts on groundwater resources are likely to come from the Contractor's project workers during the construction phase. Worker's toilets and other sanitary facilities (showers and basins) will generate sewage and wastewater which, if not properly managed, can cause nutrients, pathogens, and other bacteria to enter the ground water. While groundwater is not used on the islands for drinking water, it is possible for this pollution to enter the coastal marine environment which could potentially impact the shellfish species gleaned from the reef. Wastewater will be collected and managed at the local landfill (refer to **Section 5.3**).

5.2.1.4 Utilities

The project will require electricity and water for construction activities and for the workers accommodation. The islands supply is fragile and excessive consumption or demand from the project, particularly for energy heavy activities such as concrete production could increase the risk of disruption to the community.

5.3 Waste Management

The project advocates good waste management practices. The preferred hierarchy and principles for achieving this is: (i) waste avoidance (avoiding using unnecessary material on the Projects); (ii) waste reuse (re-use material and reduce disposing); (iii) waste recycling (recycling materials such as cans, bottles, etc.); and (iv) waste disposal (all other waste to be taken to approved landfills).

The key waste streams that are likely to be generated through the project works, include:

- Excavation wastes that were unsuitable for reuse.
- Surplus materials to requirements during the works.
- Minor concrete wastes from removal, old quay furniture (i.e., bollards).
- Wastewater from general project works and workers accommodations.
- General wastes including scrap materials.

[5] *Assuming concrete will be batched at 50m^3/day.*

Biodegradable wastes can be managed at the local landfill. The main landfill is at Jable–Batkan in Majuro, with a temporary dumpsite with JICA. At Ebeye, there is a disposal site to the northern end of the Island, alongside the causeway at Gugeegue.

For any non-organic, non-reusable and non-recyclable materials, there is a significant potential for overburdening the islands landfill if it is used for disposal of the waste. Overburdening of landfill in small islands can lead to leachate pollution of groundwater and the marine environment, disbursement of solid wastes into the marine environment due to over filling of landfill and a human health hazard due to inappropriate dumping of hazardous materials. Additionally, poor management of solid waste at work and accommodation sites can lead to a number of impacts such as pollution of local environments, community and worker health hazard and increase in pests such as rats and flies.

Sediment and soil contamination sampling

In July 2023, sediment sampling was undertaken at Delap Port and Arno Dock. The results show that all sediment samples from Delap Port had low concentrations of the majority of heavy metals, PAHS, PCBs and OC pesticides either below laboratory detection or below the default guideline values (DGVs). However, some samples had elevated concentrations of antimony, lead, zinc, TPHs and TBT above the default guideline values (DGVs)[6] and one sample exceeded the ANZG High Guideline Value (GL-High) for zinc indicating there may be some risk of impacts to aquatic ecosystem due to disturbance of these sediments. Physical analysis of the sediment at Arno Dock indicates a sandy silt with no gravel content. The results show that all sediment samples from Arno Dock had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested indicating a low risk of impacts to the aquatic ecosystem due to disturbance of these sediments. Testing results can be found in **Appendix A1**.

Soil contamination sampling was also undertaken at Delap Port and Arno Dock. The soil samples from both had low concentrations of the majority of heavy metals, PAHs, BTEX and TPH pesticides either below laboratory detection or below the assessment criteria[7]. Contaminants detected above the laboratory detection limits were primarily observed in the samples at 0.1 m.

No contaminants were reported above the adopted human health assessment criteria at locations sampled. Minor detections of select TPH fractions, heavy metals and PAHs were reported, however, not at concentrations likely to impact reuse of the soil. Testing results can be found in **Appendix A2**.

Asbestos was not identified in any sample collected, indicating the soil assessed is not classified as special waste under the EPA NSW Waste Classification guideline definition. We are not expecting the generation of hazardous wastes during the construction phase.

This preliminary waste classification is based on limited information only. If spoil requires disposal offsite, further waste classification should be conducted during the construction phase to confirm the classification.

The results showed all samples did not exceed the adopted contaminant threshold 1 (CT1) waste criteria, indicating these samples can be classified as General Solid Waste (non-putrescible) and are suitable for reuse.

Limiting waste to landfills

It is understood, that the 13,500m^3 of excavated material from the Delap Dock new pavement works will be reused in the site itself.

[6] *The results have been compared to the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG) 2018 which provides toxicant default guideline values (DGVs) for sediment and water quality.*
[7] *The results were compared to Australian and New South Wales (NSW) guidelines: NSW Waste Classification Guidelines: Part 1 Classifying waste (NSW EPA 2014) and National Environmental Protection Measure (NEPM) (2013)*

At Arno, all concrete waste can be added to the rock revetment near the dock.

Concrete that is removed at Wotje will be reused as backfill for works at the dock end. All spoil generated can be reused in the works.

At Ebeye and Jaluit, there is likely to be a significant amount of demolished concrete waste which will be stockpiled within the port facility for future use.

5.4 Traffic Management

Haulage of construction materials will be significant, contributing to potential traffic issues, particularly in Majuro. The haulage route is not yet confirmed, and selection of the route will be informed by condition of roads, government restrictions and community consultations.

All construction materials will be imported from overseas by barge or landing craft such as the MV Ribuuk Meto.

All truck movements identified below refer to two-way movements (i.e., to site and away from site). As such, numbers include for all haulage movements into and out of the site.

5.4.1 Majuro

For Majuro, the materials will be unloaded onto Delap Dock, containerised, and moved to an offsite yard via trucks. This yard will also serve as the concrete batching location, while small amounts of concrete being batched on site. Transport will involve trucking materials from the dock to the offsite yard and then to the construction site using trucks/concrete trucks.

To move 13,500 m^3 of material for the excavation works at Delap Dock, around 3,600[8] truck movements are required. Transporting the imported aggregate from the port to site would require 2150 truck movements for the approximate 8000m^3 of material required. An additional 1600 truck movements would be required for concrete to be brought to the site. Therefore, in combination, an assumed 40 trucks per day (to and from site) for approximately 170 days.

For the wharf repair works at Delap Dock and Uliga Dock works, only a small amount of truck movements is required. Excavation will be minimal and small amounts of concrete will be batched on site.

5.4.2 Ebeye

Materials will be delivered directly to Ebeye Dock via ship and all materials will be kept on site once delivered. The 500 m^3 of concrete that needs be batched will be done so on site.

5.4.3 Jaluit

Materials will be delivered to either Delap dock or Ebeye Dock, and then transferred to smaller vessels for transport to site. All materials will be kept on site once delivered. The 500 m^3 of concrete that needs be batched will be done so on site.

5.4.4 Wotje

Materials will be delivered to either Delap dock or Ebeye Dock, and then transferred to smaller vessels for transportation to site. All materials will be kept on site once delivered. The 200 m^3 of concrete that needs be batched will be done so on site.

[8] A 6-wheeler truck can transport 5m^3 and an articulated truck can transport 10m^3. The number of truck movements has been taken assuming an average of 7.5m^3/load.

5.4.5 Arno

Materials will be delivered to Delap dock, and then transferred to smaller vessels for transport to site. All materials will be kept on site once delivered. The 800 m^3 of concrete that needs be batched will be done on site.

5.5 Spills and Emergency Incidents

Spills and Emergency Response will comprise the following five key elements:

- Emergency Response – the initial onsite response which focuses on the preservation of life, the protection of property and environment, and the prevention of escalation;
- Incident Management – the direct management of the response to an incident by an Incident Management Team;
- Crisis Management – the strategic management of the medium and long-term consequences of an event or issue by a Crisis Management Team; and
- Business Continuity Management – interruptions to the delivery of Royal HaskoningDHV services and activities may require a Business Continuity Response Team to assist in returning to business as usual.

It is proposed that an Emergency Response Plan for each Site, or a combination of sites, be developed as hydrocarbon (fuel, oil, grease) spills are a real threat, although small.
The risk of spills as a result of the proposed project activities covered by this ESMP is small, however good industry practice should still be adhered to with respect to management and disposal of hydrocarbon products.

The Delap Dock pavement design incorporates oil traps. Drainage is not affected at any other sites. The full construction of the Delap Dock pavement would lead to environmental improvements.

5.6 Noise Impacts

Local noise impacts will primarily be associated with construction (machinery, power tools and delivery vehicles/vessels) and expected to be of relatively short-medium duration (4-15 months). As there are sensitive receptors nearby the ports (residential areas), noise impacts will need to be mitigated.

Operational noise changes are expected to have similar noise levels to present.

5.7 Air Quality Impacts

For most sites air quality impacts will not be a significant issue and can be mitigated by wetting down stockpiles for example. For Majuro, due to extensive transportation of materials (40 truck movements/day), air quality will be more of a concern. These impacts will need to be mitigated by using well-maintained trucks with limited exhaust emissions.

5.8 Water Quality Impacts

In July 2023, water sampling was undertaken at Delap Port and Arno Dock. The water quality analysis shows all sediment samples from Delap Port and Arno Dock had low concentrations of contaminants either below laboratory detection or below the default guideline values (DGVs)[6] for all parameters tested except copper. Testing results can be found in **Appendix A1**.

There is potential for localised and temporary increased suspended sediment levels in the marine environment around the work sites as a result of the works. Such impacts are expected to be very

minor due to the use of effective mitigation measures during construction. It is also noted that the adjacent benthic habitats are already significantly limited by port activities and of low value.

Significant water quality impacts are not expected as a result of the activities covered by this ESMP.

5.9 Flora and Fauna Impacts

The RMIMIP will involve the erection of security in the form of lighting around the ports. Light pollution can affect wildlife such as turtles and birds. These effects may include adverse effects to marine zooplankton behavior, fish aggregations at artificial light sources, invertebrate spawning behavior where lunar phase is used as a cue and displacement and/or disorientation of some marine wildlife (particularly marine turtles (hatchlings and adults) and marine birds).[9]

Despite this, the impacts from the new lighting in the RMIMIP are expected to be acceptable, particularly given the existing artificial lighting already in the area. This is particularly the case at Majuro, Ebeye and Jaluit (these shorelines are unlikely to be suitable as significant sea turtle or seabird nesting areas). Nonetheless, lighting design should consider potential impacts to marine fauna and ensure that light 'spill' is to be minimized (i.e., face lights downwards where possible, turn them off when not needed (motions sensors could be utilised)), use lower wattage if possible).

All materials imported into RMI are subject to biosecurity regulations. As such, the risk of invasive pest introduction is small.

Key impacts

The largest flora and fauna impacts are expected at Jaluit and Wotje due to the existing benthic environment and construction activities expected. At the other sites there is unlikely to be any significant impacts on both terrestrial and marine ecology due to extensive degradation due to reclamation and construction activities.

Therefore, the benthic assessment undertaken in 2023 primarily explored the impacts for Jaluit and Wotje only and are explored further below.

AtoN installation works at Jaluit and Wotje

For the AtoN installation works at Jaluit and Wotje, a large excavator (~40t size) needs to get onto land from a barge/vessel. It may require placing a rock fill ramp over the coral so the excavator can track off the barge, onto the ramp, and up onto the beach. Then the excavator will dig a hole in the beach/coral slope. A reinforced concrete foundation will be constructed inside the excavation and then the area around it will be backfilled. The excavation would disturb a max 5m x 5m area but the movement of the excavator to each location could cause additional damage to coral.

Jaluit

Benthic habitats associated with Jaluit dock supports a very low hard coral subtidal reef community that has been extensively degraded and altered due to past reclamation and construction activities. It is expected that a small number of hard coral colonies will be directly impacted by the project activities. These losses will be minor due to the limited coverage and the low ecological value of this immediate area. The substrate between the hard coral is composed of sand containing a paucity of benthic sessile invertebrates. The benthic habitat and ecosystem associated with the project sites, classified as extensively modified and disturbed with low ecological value, are expected to experience negligible potential impact from the proposed scope of works to an acceptable level.

Wotje

[9] *Davies, T.W., Duffy, J.P., Bennie, J. and Gaston, K.J., 2014. The nature, extent, and ecological implications of marine light pollution, Frontiers in Ecology and the Environment, 12(6), pp.347-355*

The works at the end of Wotje Dock and ramp involves the clearing of existing concrete debris from the seabed, where a coral habitat exists. The benthic habitats near the Wotje dock have been greatly affected by past reclamation and construction activities of the dock, resulting in a depleted reef community (hard coral and seagrass). As such, there is only a small number of hard coral colonies and seagrass in the area that might be directly impacted by the project's activities. Given their low coverage, potential losses will not be detrimental to the ecology of the site nor the species. The area is characterised by sand substrate with few sessile invertebrates. Removing existing concrete debris will have minimal impact since it is man made and the effects of its removal are minor.

5.10 UXO

The risk of Unexploded Ordinance (UXO) from World War II in the RMI remains, with an unknown number of explosive devices remaining uncleared from many atolls. Kwajalein and surrounding atolls were heavily fortified by the Japanese forces during the early years of World War II until the USA forces captured the islands in February 1944. Locals recall stories of Japanese dumping munition, and armaments including warplanes in the Ebeye lagoon before surrendering.

A desktop UXO study was undertaken on all wharf sites, and a physical site investigation was performed at the Wotje Dock and Ramp. The findings summary is as follows:

- Delap and Uliga have no UXO risk based on information gathered to date.
- Wotje Dock and Ramp – nothing was found in the localised areas able to be surveyed, however there was extensive scrap metal present at the site which limited the extent of the survey. As such a UXO surveyor would need to be present at all times during all construction works that involve any intrusive earthworks (such as any excavation and the dock end extension).
- The other sites were agreed by RMIPA that the proposed construction activities did not warrant a UXO study.

5.11 Contractor Bid Documentation

Standard environmental and social contract clauses are to be used. See ESMF Annex I.

6 Risk Assessment and Mitigation Plan

An impact risk assessment was undertaken to assess the probability (**Table 6-1**; expected, highly likely, moderately likely, not likely) and the impact of the risk (**Table 6-2**; critical, severe, moderate, minor, and negligible). From this, a significance value was attributed to the potential impact (negligible, low, medium, high).

Table 6-4 lists the proposed activities by project activity, the pre-mitigation risk (based on **Table 6-3**), proposed mitigation measures to manage the risk, the residual risk (post-mitigation) and who is responsible for implementing the mitigations.

The mitigation plan primarily focuses on project activities during the construction phase. Operational elements will pertain to RMI ports. Additionally, mitigation measures are generally applicable to all sites unless specifically noted otherwise.

Table 6-1: Rating of impact of risk

Score	Rating
5	Expected
4	Highly Likely
3	Moderately likely
2	Not Likely
1	Slight

Table 6-2: Rating of probability of risk

Score	Rating	Definition
5	Critical	Significant adverse impacts on human populations and/or environment. Adverse impacts high in magnitude and/or spatial extent (e.g. large geographic area, large number of people, transboundary impacts, cumulative impacts) and duration (e.g. long-term, permanent and/or irreversible); areas impacted include areas of high value and sensitivity (e.g. valuable ecosystems, critical habitats); adverse impacts to rights, lands, resources and territories of indigenous peoples; involve significant displacement or resettlement; generates significant quantities of greenhouse gas emissions; impacts may give rise to significant social conflict
4	Severe	Adverse impacts on people and/or environment of medium to large magnitude, spatial extent, and duration more limited than critical (e.g., predictable, mostly temporary, reversible). The potential risk impacts of projects that may affect the human rights, lands, natural resources, territories, and traditional livelihoods of indigenous peoples are to be considered at a minimum potentially severe.
3	Moderate	Impacts of low magnitude, limited in scale (site-specific) and duration (temporary), can be avoided, managed and/or mitigated with relatively uncomplicated accepted measures
2	Minor	Very limited impacts in terms of magnitude (e.g., small affected area, very low number of people affected) and duration (short), may be easily avoided, managed, mitigated
1	Negligible	Negligible or no adverse impacts on communities, individuals, and/or environment

Table 6-3: Risk matrix

Impact						
	5	High	High	High	High	High
	4	Medium	Medium	High	High	High
	3	Low	Medium	Medium	Medium	Medium
	2	Low	Low	Medium	Medium	Medium
	1	Low	Low	Low	Low	Low
		1	2	3	4	5
				Probability		

Table 6-4: Mitigation Plan

Project Activities	Pre-mitigation Risk	Mitigation Measure	Post-mitigation Risk	Responsibility
Local Community and Safety	Medium	• Implement Stakeholder Engagement Plan. • Identify key user groups for stakeholder engagement. • Conduct consultation with user groups to provide advice of planned disruptions to access. • General public is not permitted in high-risk areas and where heavy machinery is in operation. • Minimise obstacles for maintaining free access of the general public to local utilities, social gatherings and to public transport facilities. • Mark dangerous areas with reflective tape or other hazardous areas during the hours of darkness. • Contractor to prepare work plan that enables Port access to be maintained. • Ensure working areas are securely fenced and security on site during construction. • Implement GRM (ensure community aware of GRM). • Display notifications of predicted duration of disturbance of access and contact details for GRM. • Port Authority to issue Notice to Mariners, Port Operations, ferry operators, tourism operators, commercial fishing fleets, etc., advising of timing and extent of works. • Port Authorities to advise local shipping of activities and avoidance measures. • Contractor to provide written statement that marine navigation lights and other national maritime measures are closely always followed by contractors' vessel. • Liaise with Ebeye police force to ensure site security.	Low	Contractor / Port Authority
Occupational Health and Safety	Medium	• All work shall be in accordance with the World Bank Environment, Health, and Safety Guidelines for OH&S. • Contractor shall prepare and comply with an OH&S Plan, which will include a risk register and safe work method statements. • The CIU safeguards team will provide workers inductions when new workers arrive in RMI which includes the COC as well as grievance and incident reporting procedures. • Workers will be provided with SEA/SH awareness which includes the clear message that sexual exploitation of children is a crime. • Develop and implement a SEA/SH Prevention Action Plan to mitigate these risks. • PPE to be provided. • Safety plans to include Work Over Water procedures. • Buoyancy aids or life jackets to be available on vessels undertaking on and/or over water works. • Implement safety measures around construction sites to protect the public and dock workers and staff, including warning signs and information disclosure on potential safety hazards, and barriers to prevent public access to construction sites. • Security personnel may need to be used in highly populated areas, particularly where large numbers of children are expected. • The contractors camp will need a first aid post and all foreign staff will require medical cover and emergency airlift insurances. • Seek opportunities to increase employment of women. • Overseas workers will be housed in areas that are not too close to communities. **Violence Against Children**: Workers will comply with the following requirements from the COC regarding violence against children.	Medium	Contractor

Project Activities	Pre-mitigation Risk	Mitigation Measure	Post-mitigation Risk	Responsibility
		• Not participate in any sexual contact or activity with children under the age of 18, except in the case of a pre-existing marriage. Mistaken belief regarding the age of a child or "consent[10]" from the child are not an acceptable defence or excuse. • Informing their manager of the presence of any children in project offices or sites who are or may be exposed to hazardous activities. • Ensuring that another adult is present when working close to children wherever possible. • Not inviting unaccompanied children, who are not their family, into my home. • Not accessing child pornography. • Refraining from physical punishment or discipline of children. • Taking appropriate caution when photographing or filming children for work-related purposes. **Availability of housing** • Portable buildings are required for the 12–15-month pavement works project at Delap Dock. • Similar structures may be necessary for Jaluit, Wotje, and Arno (depending on the number of international workers). • For the workers installing AtoN at Jaluit and Wotje, they will be accommodated on a barge or ship. • Maximise the use of local labour and minimise the number of foreign workers used on the island to further reduce demand. **Availability of food** • Contractor is to provide food stock to manage additional demands from foreign works (for all islands excluding Majuro). • Maximise the use of local labour and minimise the number of foreign workers used on the island to further reduce demand. **Availability of water** • Prior to the commencement of works, it should be verified that the local water supply is sufficient for the number of workers at each site. • Portable desalination plant to produce potable water particularly at Delap Port (project will need to provide all freshwater needs of the workers and for construction separately to the local supply). For other repair works, local water supply should be feasible. • Maximise the use of local labour and minimise the number of foreign workers used on the island to further reduce water demand. **Availability of utilities** • Additional electricity supply for construction activities and for the workers accommodation is required.		

[10] *Consent is defined as the informed choice underlying an individual's free and voluntary intention, acceptance, or agreement to do something. No consent can be found when such acceptance or agreement is obtained using threats, force or other forms of coercion, abduction, fraud, deception, or misrepresentation. Consent cannot be given by a child under the age of 18, even where legislation in the RMI has a lower age.*

Project Activities	Pre-mitigation Risk	Mitigation Measure	Post-mitigation Risk	Responsibility
		• Maximise the use of local labour and minimise the number of foreign workers used on the island to further reduce demand. **UXO** • UXO surveyor would need to be present at all times during all construction works that involve any intrusive earthworks (such as any excavation and the dock end extension) at Wotje Dock and Ramp as scrap metal was present at the site which limited the extent of the survey. • In the event of locating UXO, all work activities in the area are to cease immediately and the UXO isolated and Superintendent notified. • The Contractor shall provide training to all staff for identification of UXOs.		

Waste Management	Low	• Implement Waste Management Plan.
		• Disposal of waste off-island of any non-organic, non-reusable and non-recyclable materials at a certified licensed facility.
		• Biodegradable wastes are to be managed at the local landfill.
		• Where possible, materials will be reused in this project or stockpiled for future use.
		  ○ The 13,500m^3 of excavated material from the Delap Dock new pavement works will be reused in the site itself.
		  ○ At Arno, all concrete waste can be added to the rock revetment near the dock.
		  ○ Concrete that is removed at Wotje will be reused as backfill for works at the dock end. All spoil generated can be reused in the works.
		  ○ At Ebeye and Jaluit, there is likely to be a significant amount of demolished concrete waste which will be stockpiled within the port facility for future use.
		• Where possible, purchase prefabricated goods to reduce waste.
		• All wastewater from concrete production will be collected and treated to lower the pH and allow particulates to settle out before being recycled for construction purposes.
		• Treated and tested wastewater may be discharged for absorption into the ground. Discharge will be at a rate to allow absorption without causing surface flooding.
		• Slurry from concrete production will be collected and treated. Treatment can vary depending on viscosity of slurry but can include the same measures described for treating concrete wastewater or can be by facilitating the solidification of the slurry to form a gel which can be stored and disposed of according to the Solid Waste Management Plan.
		• Solid and cured concrete waste is considered safe to be reused by the community or the GoRMI for infrastructure maintenance.
		• Segregated storage for solid waste will be provided. This area will be clearly marked and designed to ensure that waste is secure.
		• Maximise the use of local labour and minimise the number of foreign workers used on the island to further reduce waste generation.
			Low	Contractor

Aggregate	Low	• No sand or aggregates will be sourced from any quarry, borrow pit or beach in RMI. • Internationally sourced aggregates will be from licensed permitted source, sustainable extracting materials and operating in compliance with its permit conditions. • Provide an approved phytosanitary certificate and any other documentation required under RMI legislation prior to dispatch from country of origin.	Low	Contractor and RMI

Project Activities	Pre-mitigation Risk	Mitigation Measure	Post-mitigation Risk	Responsibility
		• Present biosecurity and quarantine approvals along with any import permits to Supervision Engineer for clearance before offloading any materials.		
Construction impacts	Medium	• Contractor to prepare CEMP. • The CIU and RMIPA must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to air quality/noise limits are exceeded.	Low	Contractor
Traffic Management	Medium	• Development of a Traffic Management Plan, confirming haulage route (informed by condition of roads, government restrictions and community consultations). • The TMP will particularly focus on the movement of heavy plant and the haulage of materials. • The Contractor will be responsible for repairing any damage caused to the roads due to the haulage of materials to the same or better condition surveyed in the pre-construction assessments. • Only roads designated and approved in the TMP shall be used for haulage and transportation.	Low	Contractor
Noise Impacts	Medium	• Minimise nuisance from noise, especially closer to residential areas and sensitive receptors, through establishment and communication to affected parties of working hours, including night works and avoid increase of noise and number of work equipment at outside of advertised hours. Advertise working hours at the site entrance. • Use noise barriers / screens or mounds to shield sensitive receptors from any processing or batching plant activity. • Workers in the vicinity of sources of high noise shall wear necessary protection gear rated for the situation they are being used. • Signage to outline complaints procedure (GRM) and contact details of recipient of complaints. • The World Bank/IFC EHS Guidelines 113 Section 1.7 – Noise Management shall be applied. Noise impacts will not exceed the levels at the closest residential or other sensitive social receptors for one hour LAeq of 55 dBA between the hours of 0700-2200 or 45 dBA outside of these hours for night works or result in a maximum increase in background noise levels of 3dB at the nearest receptor location off site. The nearest sensitive receptors are the closest residences to the active works and to the laydown site. • Where possible limit construction activities to daytime hour unless permission is obtained from Supervision Engineer. • Acceptable working hours need to be established through consultation with the local stakeholders, in particular the Police and Local Government authorities. Any working hours that are considered to be anti-social will be avoided at all costs. For example, working overnight, during weekends or on public holidays can be considered anti-social because it may interfere with the worker's ability to spend time with their loved ones or engage in social activities. • Haulage and other vehicle movements should be restricted to day-time hours only given the risks to pedestrians (particularly the children).	Low	Contractor
Air Quality	Medium	• Cover or wet down stockpiles containing fine material (e.g., sand and topsoil) when not actively being used. • Manage speed of transportation trucks.	Low	Contractor

Project Activities	Pre-mitigation Risk	Mitigation Measure	Post-mitigation Risk	Responsibility
		• The requirement for dust suppression will be visually observed by site personnel daily and by RMIPA and CIU staff when undertaking routine site inspections. • Ensure equipment selected is acceptable in terms of emissions. • Ensure equipment and machinery is regularly maintained and appropriately operated. • All machinery to use low emission fuels.		
Water Quality Impacts	Medium	**Erosion and sediment control** • Contractor to develop and apply an Erosion Sediment Management Plan (ESMP), Erosion, Drainage and Sediment Control Plan (EDSCP) and Contaminated Soil Disposal Management Plan. • Stockpiles of sand shall be no more than 2 m high, shall be bunded at the base using sandbags or similar to prevent sediment laden run off and erosion of stockpiled materials. Stockpiles should be covered. • Machinery should be washed down off site within a bunded location. • Contractor to ensure runoff from material stockpiles is contained and treated prior to any discharge. • Obtain earthworks permit from RMI EPA. **Spills and emergency incidents** • Contractor will have a spill response procedure and associated spill kits to contain any incidental spillage of fuel, chemicals and hazardous waste. • Concrete will be prepared in bunded hard stand surface. • Silt fences to be established where required. • The contractor will be required to ensure all equipment is properly maintained and operated and to prevent spillage of petrochemicals into the marine environment. • Fuels, lubricants will be stored in dedicated storage area having secondary containment. • Hazardous wastes generated from the site construction stage will be stored in designated waste storage area, with secondary containment. • No refuelling of machines or vehicles will be permitted in the marine environment.	Low	

Flora and Fauna Impacts	Medium	• For AtoN installation works at Jaluit and Wotje, limit excavation works to as small an area as possible.
		• Ensure that all lighting is established so as it does not impact marine communities.
		• For the repair and upgrading of navigation aids including but not limited to the attachment of buoys and blocks to the deeper seabed in the anchorage, mitigation measures will be planned on a case-by-case basis - but will be either:
		  ○ the temporary relocation of coral heads/benthos for replacement when work is completed, and propagation of corals that may be damaged for return to the environment when work is completed; and/or
		  ○ removal of corals for later return, propagation of corals for later return and hardening of the impacted area to allow proper recolonisation.
		• The removal of existing concrete debris from the seabed at Wotje Wharf (where a coral habitat exists) will either incorporate the placement of concrete debris with coral heads elsewhere in the reef to enable survival.
			Low	RHDHV / Contractor

7 Grievance Redress Mechanism

While the ESMF discusses the grievance redress mechanism in Section 10 and Annexure R, an updated and project specific Grievance Redress Mechanism (GRM) has been included below.

7.1 RMI Judiciary Level Grievances

The project level process will not impede affected persons access to the RMI legal system. At any time, a complainant may take the matter to the appropriate legal or judicial authority as per the laws of the Republic of the Marshall Islands.

7.2 Process

The GRM has been designed to be problem-solving mechanism with voluntary good-faith efforts. The GRM is not a substitute for the legal process. The GRM will as far as practicable, try to resolve complaints and/or grievances on terms that are mutually acceptable to all parties. When making a complaint and/or grievance, all parties must always act, in good faith and should not attempt to delay and or hinder any mutually acceptable resolution.

The GRM covers the entire duration of the project. It recognises that complaints can come at any time, including pre-design, design, construction, and post-construction. The process for the GRM is shown in **Figure 7-1** and **Table 7-1**.

In addition, to the project-level and national grievance redress mechanisms, complainants have the option to access the World Bank's Grievance Redress Service, with both compliance and grievance functions.

Communities and individuals may request a Grievance Redress Service process when they have used standard channels for project management and quality assurance and are not satisfied with the response (in this case the project level grievance redress mechanism). For information on how to submit complaints to the World Bank Inspection Panel, visit www.inspectionpanel.org.

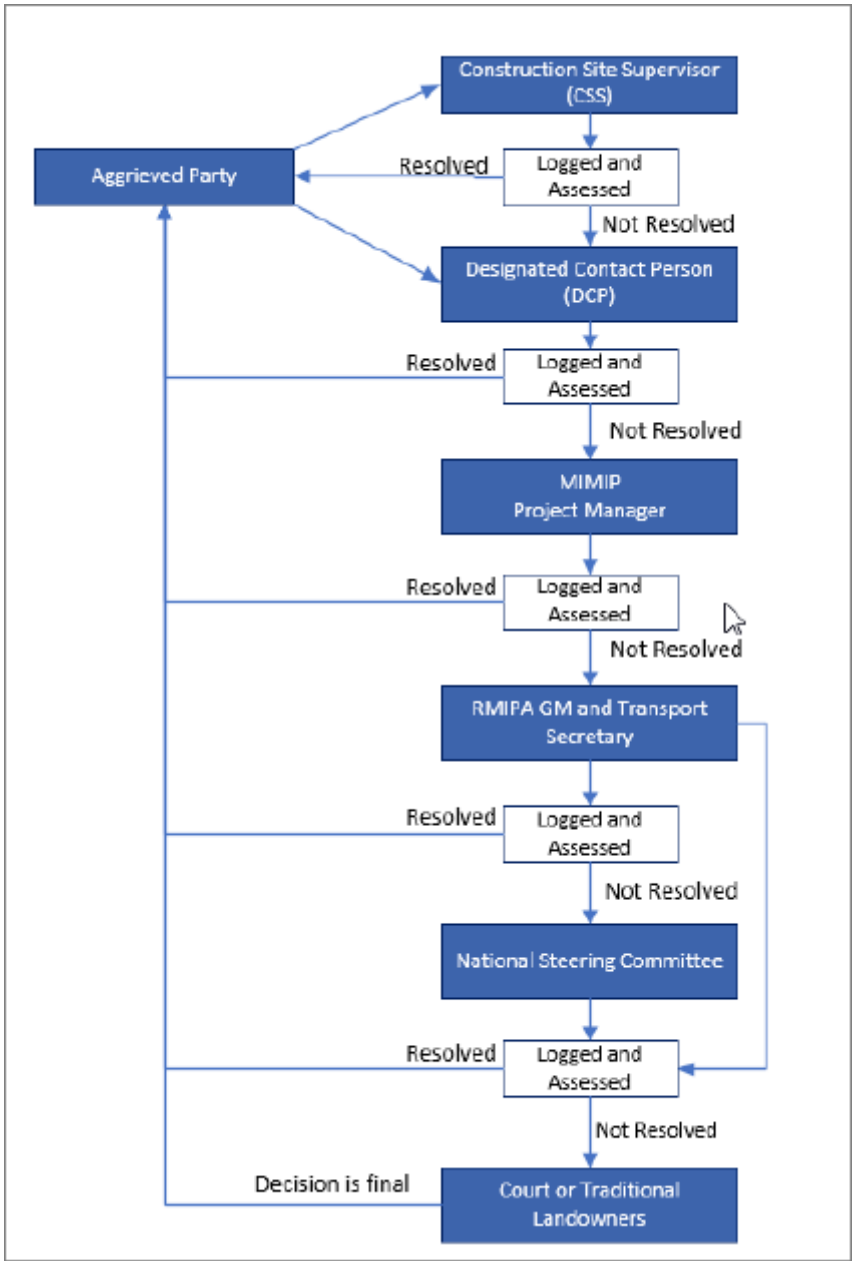

Figure 7-1: RMIMIP Grievance Redress Mechanism

Table 7-1: GRM process (source: DIDA)

Stage	Process	Duration
1	Aggrieved Party (AP) takes their grievance to either Construction Site Supervisor (CSS) or Designated Contact Person (DCP) – obviously in the pre-construction period there will be no CSS and the DCP is the appropriate person. Once construction commences, the CSS becomes the initial focal point for information. If the AP contacts any of the Project Representatives set out in Section 3, those Project Representatives will communicate the grievance to the DCP or CSS. **Pre- and post-construction –** DCP endeavours to resolve it immediately. Where AP is not satisfied, the DCP will refer the AP to the RMIMIP Project Manager. For complaints that were satisfactorily resolved by the DCP, the incident and resultant resolution will be logged and reported to the RMIMIP Project Manager. **Post-construction commencing –** CSS endeavours to resolve issue immediately. Where AP is not satisfied, the CSS will refer the AP to the DCP. For complaints that were satisfactorily resolved by the CSS, the incident and resultant resolution will be logged and reported to the RMIMIP Project Manager. Complaints records (letter, email, record of conversation) are stored together, electronically or in hard copy. Each record is allocated a unique number reflecting year and sequence of received complaint (i.e., 2018-01, 2018-02 etc.).	Anytime
2	On receipt of the complaint, the Project DCP endeavors to resolve it immediately. For complaints that were satisfactorily resolved by the DCP, the incident and resultant resolution will be logged by the DCP and reported to the RMIMIP Project Manager. If unsuccessful, DCP then notifies RMIMIP Project Manager	Immediately after logging of grievance.
3	The RMIMIP Project Manager endeavors to address and resolve the complaint and inform the aggrieved party. For complaints that were satisfactorily resolved by the RMIMIP Project Manager, the incident and resultant resolution will be logged by the RMIMIP Project Manager. The RMIMIP Project Manager will refer to the RMIPA General Manager and Transport Secretary other unresolved grievances for his/her action/resolution.	2 weeks
If the matter remains unresolved, or complainant is not satisfied with the outcome:		
4	The Transport Secretary will then refer to matter to the Project Steering Committee (PSC) for a resolution. The RMIMIP Project Manager will log details of issue and resultant resolution status.	1 month
5	If it remains unresolved or the complainant is dissatisfied with the outcome proposed by the PSC, he/she is free to refer the matter to the appropriate legal or judicial authority. A decision of the Court will be final.	Anytime

7.3 Complaints Register

A complaints register will be established as part of the RMIMIP to record any concerns raised by the community during construction. Any complaint will be advised to the World Bank and DIDA within 24 hours of receiving the complaint. The complaint will be screened. Following the screening, complaints regarding corrupt practices will be referred to the World Bank for commentary and/or advice. Wherever possible, the RMIMIP team will seek to resolve the complaint as soon as possible, and thus avoid escalation of issues. However, where a complaint cannot be readily resolved, then it must be escalated. A summary list of complaints received, and their disposition must be published in a report produced every six months by DIDA and RMIPA.

8 Stakeholder Consultation

8.1 Introduction

A detailed Stakeholder Engagement Plan (SEP) was developed in the ESMF. Refer to Section 9 of the ESMF and Annexure Q.

To date, the RMIMIP has been discussed with a wide range of stakeholders including relevant government departments, industry groups, NGOs, and individual community members and approved by Government. On-ground consultation has been undertaken during the design of the RMIMIP and it is expected that consultation with stakeholders and any affected communities will continue throughout the project.

A significant change since the SEP's initial development is that the timing for execution of the designed works is unknown due to funding constraints, and it is unlikely that all designed works will be executed in the short term. The existing SEP was comprehensive and based on a broad set of anticipated environmental and social impacts. If high environmental and social risk works do not proceed, the necessity for extensive consultations across different islands is diminished.

8.2 Revised approach

To avoid creating inaccurate expectations within the community, potential disappointment, and reputational issues, the proposed stakeholder engagement approach has been revised as follows:

- Consultation will occur when the exact scope of works becomes known i.e., when materials are ordered.
- A facilitated consultation by the Project Implementation Unit (PIU) will bring key stakeholders together to explain the upcoming program of works. Signage will inform users and workers at the port, and a clearly posted grievance procedure will be in place. Emphasis will be on the primary stakeholders within the port grounds, addressing issues such as worker communication, safety and coordination with law enforcement for managing additional traffic loads.
- Bi-monthly updates, in the form of newsletters/emails, will be disseminated to keep stakeholders informed of project developments. The schedule of works can be communicated through this medium.

Key stakeholders identified for engagement will include:

- Users of the ports
- Port workers
- RMIPA stevedores
- Travelling public
- Shipping companies
- Pilots
- Customs
- Search and rescue
- Port security

A publicised telephone number will be maintained throughout the RMIMIP to serve as a point of contact for enquiries, concern, complaints and/or grievances. All enquiries, concern, complaints and/or grievances will be recorded on a register and the appropriate manager will be informed.

Where there is a community issue raised, the following information will be recorded:

- Time, date and nature of enquiry, concern, complaints and/or grievances;
- Type of communication (e.g., telephone, letter, personal contact);
- Name, contact address and contact number;
- Response and investigation undertaken as a result of the enquiry, concern, complaints and/or grievances; and
- Actions taken and name of the person taking action.

Some enquiries, concern, complaints and/or grievances may require an extended period to address. The complainant(s) will be kept informed of progress towards rectifying the concern. All enquiries, concerns, complaints and/or grievances will be investigated, and a response given to the complainant in a timely manner. A grievance redress mechanism has been included in the ESMF, and updated within this ESMP to address any complaints that may not be able to be resolved quickly.

Nominated DIDA (or its delegate) and/or RMIPA and contractor staff will be responsible for undertaking a review of all enquiries, concern, complaints and/or grievances and ensuring progress toward resolution of each matter.

Appendices

A1 Benthic assessment November 2023

Environmental Assessment Document

Republic of the Marshal Islands (RMI) Maritime Investment Project (P161382)
Design and Supervision of Safe, Efficient and Climate Resilient Maritime Infrastructure in the (RMI) – Part 1: Detailed Engineering Design

November 2023

Marine Ecological Assessment
Arno Dock, Jaluit Dock & Wotje Dock and Ramp



Prepared by Marine Ecologist Specialist

Acronyms

cm	Centimeters
EEZ	Economic Exclusive Zone
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
IUCN	International Union of Conservation of Nature
GPS	Global Positioning System
km	Kilometers
MSL	mean sea level
m	Meters
MES	Marine Ecology Specialist
MIMRA	Marshall Islands Marine Resources Authority
RMI	Republic of the Marshall Islands
SCUBA	Self Contained Underwater Breathing Apparatus
TOR	Terms of Reference
WB	World Bank

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1 Table of Contents

1.0 EXECUTIVE SUMMARY

The World Bank (WB) and Republic of the Marshall Islands (RMI) have financed the RMI Maritime Investment project (P161382) which includes the upgrading of several of the nation's outer island docks and ramps. This is to be delivered under a design and supervision consultancy for the safe, efficient and climate resilient Maritime infrastructure project.

The project is focused on existing maritime facilities at six existing ports/docks in RMI: Majuro (Delap and Uliga), Ebeye, Jaluit, Wotje and Arno. The works are limited to the port boundaries, i.e. land currently occupied by the ports and immediate waters (existing channels and berth pockets) and associated Aids to Navigation (AToNs). This marine benthic assessment includes the three outer island projects associated with Arno, Jaluit and Wotje atolls.

As part of the projects safeguard due diligence, a Marine Ecology Specialist (MES) working directly with the design and supervision contractors environmental safeguards team has been engaged to undertake a marine assessment of the marine benthic habitats and ecosystems associated with the three docks (Arno, Jaluit and Wotje) and one ramp (Wotje atoll). This report details the marine assessment findings, potential environmental impacts and recommended mitigation options for all three outer atoll project sites.

A marine biological baseline assessment was undertaken on the coastal and marine biomes associated with intertidal and shallow subtidal marine habitats and benthic substrate directly associated with the shallow water marine dock and ramp upgrades within Arno, Jaluit and Wotje atolls.

The marine assessment data collection was undertaken during the months of June and July 2023 for all atoll sites using free diving (snorkeling) and SCUBA qualitative and quantitative benthic habitat and resource assessment scientific visual survey methods.

In total, one free dive and SCUBA site was undertaken for the dock in Arno, Jaluit and Wotje each whilst an additional free dive was undertaken for the ramp in Wotje atoll. The free dives and SCUBA included the marine benthic abiotic and biotic habitats and resources surrounding the docks and ramp (direct areas of influence). Each Free dive and SCUBA recorded (photo/video) the benthic biotic (fauna and flora) and abiotic resources. The area assessed differed between each site undertaken at each of three atolls. Total assessed areas for the docks at Arno, Jaluit and Wotje was 5,070 m^2, 1,417 m^2 and 15,330 m^2 respectively, whilst an additional 31,157 m^2 was undertaken associated with the Wotje ramp. In total an area of 52,974 m^2 (5.2 hectares) was undertaken for all sites. Water depth varied between atoll sites and includes <1-4 m, <1-5 m and,1–3 m for Arno, Jaluit and Wotje sites respectively.

Detailed benthic habitat and resource assessment findings for each of the project docks and ramp are presented in the individual chapters of this report and should be referred for full baseline information.

The marine assessments sites assessed for Arno, Jaluit and Wotje atoll docks and Wotje atoll ramp do not impact any marine (intertidal, subtidal or lagoon) or coastal conservation and/or protected area/s, sites of cultural, customary or heritage significance nor any national or international marine or coastal (terrestrial) endangered

or protected species. Thus there are no impacts on critical habitats associated with the dock/ramp projects.

Key summary findings of the marine benthic assessment of the three docks and one ramp are summarized below and includes:

- Coral reefs were associated with all three (3) docks and one (1) ramp sites.
- The coral reef ecosystem impacted by the projects at all sites recorded a similar benthic zonation including; a coastal sand beach (reclaimed and impacted at all sites) with a hard bedrock base layer dominated by varying proportions of coral sand, coral rubble and rocks; an intertidal reef flat which varied in linear width, ranged in water depth between 0–1 m and is exposed in part during low spring tides (e.g. Arno Atoll site); a subtidal reef flat which varied in linear width, ranged in water depth between 1-3m and a gentle vertical sloping sand lagoon (Jaluit and Wotje sites).
- The reef zones impacted by the project include; foreshore beach and intertidal lagoon areas only for Arno Atoll dock, whilst the foreshore beach, intertidal, subtidal and lagoon areas for Jaluit and Wotje sites.
- Significant foreshore and marine impacts are associated with all sites, including extensive past dredging activities associated with the Arno dock resulting in significant abiotic changes to the benthic environment and subsequent impact to benthic resources.
- Increased sedimentation has resulted from past benthic alterations (impacts) at all sites.
- No estuaries or rivers/streams were associated with any of the project sites.
- Hard coral percent live coverage, morphological form, diversity and abundance varied between all sites and reef zonation.
- No soft corals nor mangroves were recorded associated with any of the sites.
- The subtidal reef flat at all sites recorded the highest hard coral percent coverage, population densities and diversity.
- Hard coral morphology varied between the sites reflecting the natural environmental forces affecting the different reef locations.
- Hard coral species diversity, abundance and morphological form was low at all sites due in part to the natural ecosystems at these sites, however past reclamation and alteration activities has significantly altered and reduced these parameters.
- Hard coral digitate (e.g. *Porites sp.),* branching (e.g. *Acropora sp*., *Pocillopora sp.),* sub massive (e.g. *Porities sp*.,) morphological forms dominated the reef systems associated with all sites.
- There was an absence of large massive coral heads, plates and table corals at all sites.
- Hard coral recruited was recorded at all sites, however numbers of new recruits and small juvenile corals at all sites was very low thus providing direct evidence of natural hard coral recruitment is active in these areas, albeit in low numbers.
- No were no Crown of thorn starfish, hard coral predator gastropods (*Drupella sp*.) nor hard coral viruses were located during the assessment at any site.
- Isolated small colonies (patches 1m^2) of sea grass (*Enhalus acoroides)* were recorded at the Wotje dock and ramp only. Their presence was recorded in close proximity to the dock and ramp and through anecdotal information are recorded throughout this section of the Wotje atoll. Impacts perceived from the projects development on these resources are expected to be very minor.
- Marine macro algae density, coverage and diversity varied at each site with significant percent coverage recorded for areas associated with the dock and

ramp for all sites. Wotje and Arno atolls sites recorded percent coverage in excess of 80%.

- The dominate marcoalgae recorded at all sites included the brown algae (*Padina sp.* and *Dictyota sp,), the red algae (Laurencia sp.) with isolated populations of the green algae Halimeda sp*. The red crustose coralline algae was only located at the Arno dock site.
- Finfish population numbers and species diversity was low at all sites assessed. Species that were present were juveniles and include reef dwelling plankitvores (small fish), herbivores (e.g. Acanthuridae, Scaridae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates (apart from corals) were recorded at all assessed sites. Those that were recorded have no subsistence or commercial value, indicating high level of specific resource exploitation.
- Garbage (e.g. machinery, equipment) was located on the seafloor at all sites with Jaluit dock possessing significant levels of material in close proximity to the dock. Physical clean up at all sites should be considered.
- Past reclamation activities including the construction of the docks and ramp at all sites has significantly degraded water quality (e.g. high siltation levels, reduction of benthic habitat) and hard coral communities in close proximity to this site are negatively impacted including hard coral colony mortality. Arno dock site possessed the highest levels of suspended sediment and poor water clarity in and around the dock, especially the southern site (dredged site). The siltation associated with the Arno dock site has been discharge onto the outer reef systems adjacent to the dock causing significant hard coral mortality.
- The elevated level of suspended sediment coupled with the significant benthic sediment layer (silt) on the seafloor at all sites has had a detrimental effect on the ability of sessile benthic marine resources to settle (recruit) and survive.
- There were no threatened, endangered or endemic hard coral species located during the assessment for the reef systems within the direct and indirect Area of Influence for all docks and ramp.
- There are no marine or coastal designated marine protected areas or areas of significant biodiversity within or in close proximity to the dock/ramp sites.
- There are no sites of cultural, customary or heritage significance nor any national or international endangered or protected species within or in close proximity to the dock and ramp sites.
- The benthic substrate and resources at all docks and ramp sites are highly modified by past anthropogenic impacts (dock/ramp construction, dredging and shoreline reclamation activities) and as such the benthic habitat at all sites can be considered to have low habitat and ecological value.

Potential Impacts: The impacts derived from the marine scope of works for the upgrading of the Arno, Jaluit and Wotje docks and Wotje ramp are expected to be minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures. There are no threats to the area's marine and coastal biodiversity associated with the projects. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, mitigatable and overall insignificant.

Mitigation Measures: Recommended mitigation measures during the construction phase of the project should ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the sites. The use of silt curtains are not recommended due to

the water movement in and around the docks and ramp and the natural dispersion of sediments during tidal exchanges.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore, due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works.

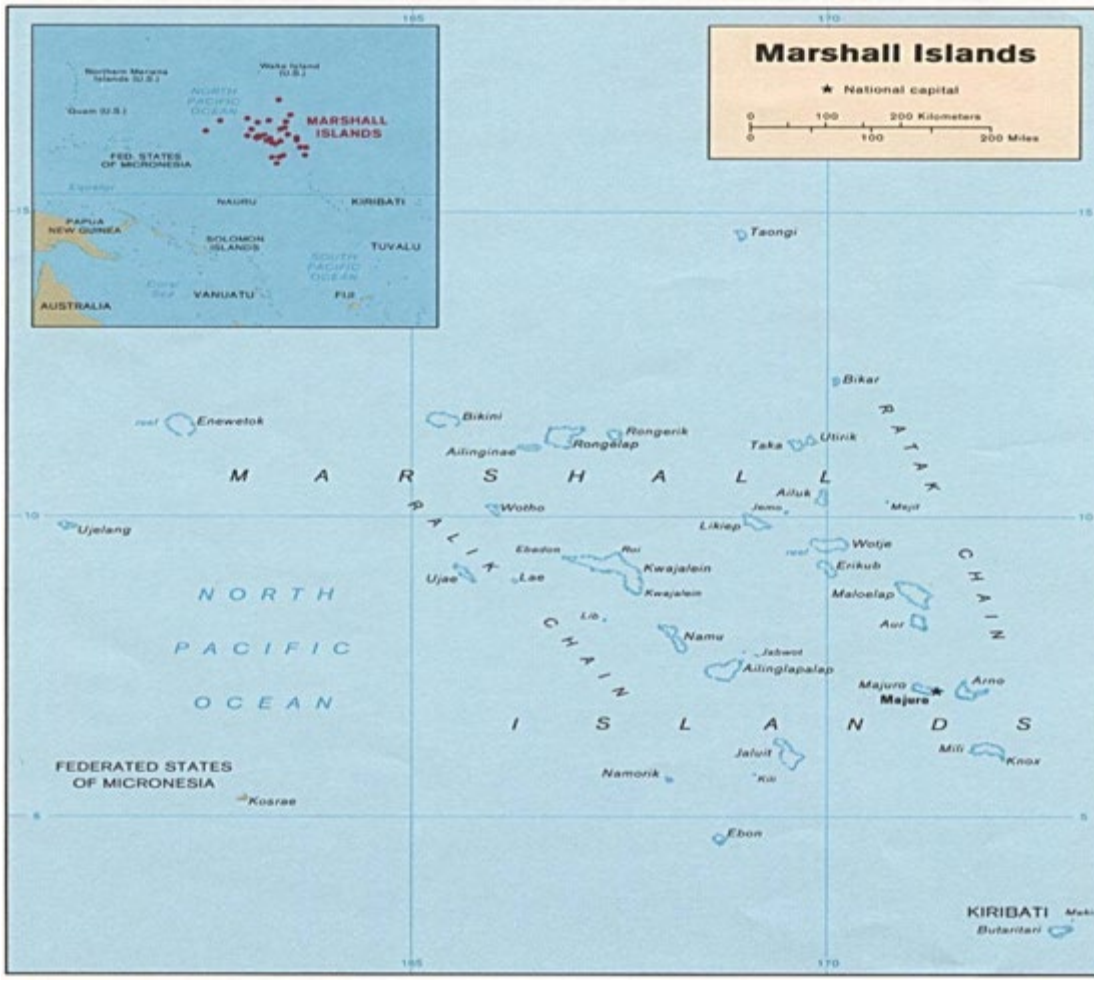
2.0 INTRODUCTION

2.1 Background

The Republic of the Marshall Islands (RMI), which is located approximately midway between Hawaii and the Philippines, consists of 29 atolls, 5 low elevated coral islands and numerous small islets with the highest elevation of 8 meters (m) and are located in the north central Pacific ocean. The country covers an area of 1.9 million square kilometers (km^2), but has just 181 km^2 of land area (Figure 1). The atolls and islands within the archipelago consist of two roughly parallel island chains: the western “Ralik” (“sunset”) and eastern “Ratak” (“sunrise”) chains. The atolls extend approximately 1130 km north to south, from 14°43’N – 4°34’N and approximately 1290 km east to west, from 160°48’E – 172°10’E.

The majority of the islands are inhabited with and overall population of about 55,000, of which over half the population resides in the national capital of Majuro with remaining population residing either on Ebeye Island on Kwajalein Atoll, a large US military installation or on the scattered atolls within the nation.

Figure 1: Locality map of the Marshall Islands and neighboring nations.



Traditional, social and cultural institutions are very strong. Marshallese society is based on the extended family, which is responsible for the family welfare, especially in relation to customary family land. Ownership of land and marine areas varies between

islands. However, the majority of land and marine areas within five nautical miles outside the reef (ocean side) are owned by the communities through traditional land ownership and managed in conjunction with atoll local governments.

All marine zones within RMI atolls below the Mean High Water Mark (MHWM) falls under the jurisdiction of local councils and governments. RMI Law, Title 9, Public Lands and Resources, Chapter 1: Section 103. “Rights in areas below high water mark. (1) that portion of the law established during the Japanese administration of the area which is now the Republic that all marine areas below the ordinary high water mark belong to the government, is hereby confirmed as part of the law of the Republic”. Land cannot be sold to non-citizens of the RMI. These land and marine ownership patterns greatly influence and complicate access usage of marine resources and therefore play a critical role in the collection of lagoon-based aggregates for the nation’s development requirements.

The national constitution of the RMI is the basis for legal authority and decision making in the nation. In addition to the western-style democratic government, a traditional Marshallese governing system including a council of 12 paramount chiefs acts as an advisory body to the national government, especially on matters that affects customary land, law, traditional practices and land tenure.

Each inhabited island within the nation through its elected local councils holds jurisdiction over their own atoll including land, lagoon and water up to 5 nautical miles offshore from their reefs. These local governments are based on the national legislative system and have the powers to introduce laws and regulations pertinent to their atoll’s affairs. In addition, the traditional hierarchal system of land owners plays a vital role in each atoll’s management. The local island councils and traditional owners therefore, have jurisdiction over the majority of coastal areas and therefore are responsible for regulations and enforcement for all marine activities including the development of marine structures (e.g. docks) and abiotic and biotic resource collection.

The project’s Environmental and Social Management Framework (ESMF) provides a clear description of the environmental and marine legislative requirements of the project and should be referred, this information is not repeated herein.

2.2 Project Description

The projects development objective (PDO) is to improve the safety, efficiency and climate resilience of maritime infrastructure and operations in the Republic of the Marshall Islands, and in the event of an Eligible Crisis or Emergency, to provide an immediate response to the Eligible Crisis or Emergency.

The project is focused on existing maritime facilities at six existing ports/docks in RMI: Majuro (Delap and Uliga), Ebeye, Jaluit, Wotje and Arno. The works are limited to the port boundaries, i.e. land currently occupied by the ports and immediate waters (existing channels and berth pockets) and associated Aids to Navigation (AToNs). This marine benthic assessment includes the project three outer atoll projects associated with Arno, Jaluit and Wotje atolls.

The projects summary activities for the three outer island sites include:

- The Arno dock refurbishment will have concrete infrastructure repairs undertaken both above and below the water resulting in a relatively small

footprint both terrestrially and within the marine environment. The scope of woks includes; concrete overlay of the dock surface, replacement of the dock fenders, and bollards, new lighting and structural repairs to the concrete stairs.

- The Jaluit dock will have concrete infrastructure repairs undertaken both above and below water, resulting in a relatively small footprint both terrestrially and within the marine environment. The scope of woks includes; replacement and the addition of new fenders, concrete pavement repairs (above and below water) , repairs to the sheet pile wall (welding of steel plates under water), new lighting, installation of new cathodic protection system to the sheet pile wall, repainting of bollards and sheet piles above water, installation of a safety ladder
- The Wotje dock and ramp will have concrete infrastructure repairs undertaken both above and below water resulting in a relatively small footprint both terrestrially and within the marine environment. The scope of works for the dock includes; extensive concrete block wall repairs – mortar and block repairs, new concrete pavement for the dock entry, and the removal of historical rubble adjacent to the dock head whilst scope of works for the ramp includes; new concrete pavement slabs, concrete patch repairs to the road pavement and the relocation of the Marshall Islands Energy oil transfer connection Pipeline

2.3 Project Geographic Area

2.3.1 Arno Atoll Dock

Arno Atoll is located approximately 20 km direct west of Majuro (refer Figure 1), is approximately 44 km in length and 39 km wide at its widest point. The atolls total land area covers 13 km^2, and includes three different lagoons, a large central one covering 339 km^2 and two smaller ones in the north and south. Water exchange occurs through three main reef passes and across the reef flats at high water.

Arno's dock (7^{0}02'55.27"N and 171^{0}33'54.96"E) is situated on a seaward intertidal shoreline in the south-western end of the island of Arno. The dock has a single berth for a ship and is approximately 75 m long. It has a concrete top and stairs on the eastern side providing access to water level. At the landward end of the dock there is a building approximately 12 m x 15 m and a small landing ramp. Vessels utilize the eastern side of the dock where the water is deepest.

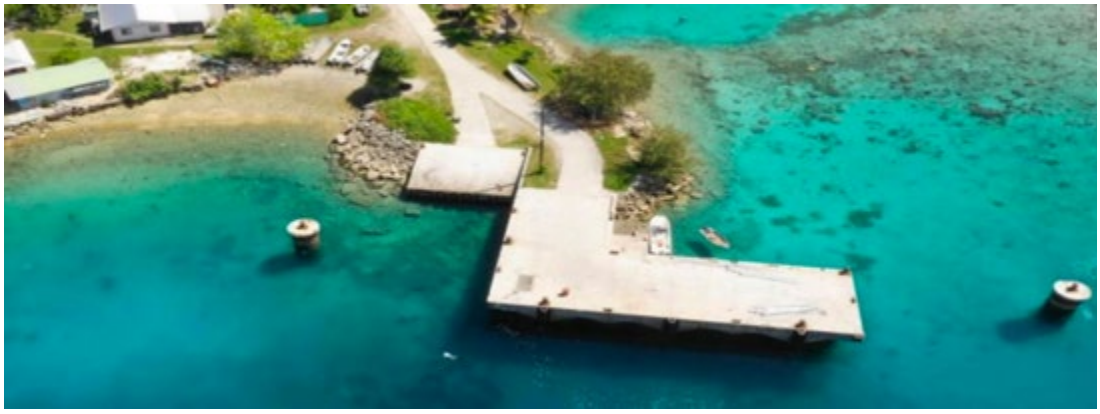
Plate 1: Arno Dock, Arno Atoll, RMI.

2.3.2 Jaluit Atoll Dock

Jaluit Atoll is the southern district center of the RMI, located approximately 230 km southwest of Majuro, the nation's capital (refer Figure 1), is approximately 60 km in length and 34 km wide at its widest point. The atoll covers 690 km^2 and includes a land area comprising of 91 islets (motu) covering an area of 7 km^2. Water exchange occurs through three main reef passes and across the reef flats at high water. Jaluit was the capital of the Marshall Islands during the German (1878-1914) and Japanese (1914-1943) administrations.

The only dock in Jaluit atoll (5^{0}55'12.89"N and 169^{0}38'29.36"E) is situated on the leeward, lagoon intertidal and subtidal shoreline in the south western end of the atoll (Plate 2). The dock has one single berth for a ship and a roll on roll off facility on the northern side, the structure is approximately 33 m long by 10 m wide. There are dolphins off the northern and southern ends of the wharf, otherwise there are limited facilities associated with the wharf. A single lane coralline gravel road provides access from the dock to the nearby village. The nearest urban development is approximately 75 m from the front face of the wharf.

Plate 2: Jaluit Dock, Jaluit Atoll, RMI.



2.3.3 Wotje Atoll Dock and Ramp

Wotje Atoll is located approximately 290 km north northwest of Majuro (refer Figure 1), is approximately 20 km in length and 48 km wide at its widest point. The atoll lagoon covers 624 km^2 and includes a land area comprising of numerous islets (motu) covering an area of 8.1 $km^{2.}$ Water exchange occurs through two main reef pass complexes and across the reef flats at high water.

The dock ($9^0$27'23.01"N and $170^0$14'01.52"E) and the ramp ($9^0$27'36.76"N and $170^0$13'53.87"E) are situated on the lagoons leeward side of the intertidal shoreline in the eastern corner of Wotje atoll (Plate 3) and both were constructed by the Japanese prior to WWII. The dock is located approximately 450 m to the south of the ramp and both extended approximately 170 m and 200 m respectively, from the shoreline into the lagoon (Plate 3). The dock has facilities consist of a concrete, earth filled finger wharf. There is a small boat landing area on the southern side of the dock. Large vessels are unable to directly use the dock. The dock was extensively damaged by bombing in WWII – debris is scattered in the water around the outer end of the dock. The ramp consists is a concrete structure that is in poor structural shape and is used to transfer petrochemical products onto the Island. Both facilities have limited facilities. A single lane coralline gravel road provides access from the dock and ramp to the nearby village.

Plate 3: Wotje Dock and Ramp, Wotje Atoll, RMI.

2.4 Marine Environments

The Marshall islands geomorphological structures consist of only coral atolls and raised limestone islands that are surrounded by an outer barrier reef which is interrupted at intervals by water passes allowing water to enter the lagoon.

The nation's complex marine habitats stretch from Ebon atoll (4°35'58.33"N, 168°41' 56.65"E) in the south to Bokaak (Taongi) Atoll (14°38'46.86"N, 168°58'29.27"E) in the north. The atolls vary in size from Kwajalein, the largest in the world with a lagoon area of 2,174 km^2, to Namdrik atoll with a lagoon area of only 8.4 km^2. The nation has an Exclusive Economic Zone (EEZ) of 2.001,385 km^2 with a total land area of 181 km^2.

Coastal resources, especially close to urban centers of Majuro and Ebeye, are over exploited. Inappropriate and unsustainable fishing practices are being employed. These practices have led to increased competition between resource users and have accelerated resource depletion, habitat alteration, degradation and in some cases destruction of the habitat. Coastal degradation due to poor land use management practices, sand mining and dredging operations (terrestrial and marine), land reclamation (ocean and lagoon areas) and pollution especially in the urban centers of Majuro and Ebeye is a growing concern for the nation.

Coral reefs and their associated ecosystems and biomes are the only shallow marine feature of the nation. All major types of coral reefs are found within the RMI, including barrier reefs, fringing reefs, large lagoons and submerged reefs. These biomes include mangrove forests (albeit restricted to several atolls only), sea grass beds, algal beds, and foraminifera and coral sand lagoons.

The basic tide parameters throughout the Marshall islands includes a maximum tidal variation of lees than 2 m (meso-tidal) and are semi diurnal (2 tides a day) with a diurnal

inequality and considerable daily variability in amplitude. The annual range of sea water surface temperature ranges between 27-30 degrees Celsius. Inclement weather systems (e.g. tropical storms) have a marked impact on tidal height and cause increased coastal erosion if they coincide with high water periods.

The nation has no permeant rivers or streams. Groundwater seepage is the main mechanism by which dissolved contaminants and nutrients move from the terrestrial environment to the marine. In general there is no surface freshwater runoff from the atolls due to their low-lying, porous nature and small land areas, however runoff can occur in urban environments where hard surfaces predominate.

Atolls within the RMI shows the typical morphology of a coral reef associated with a Pacific atoll from the sea ward side to the lagoon and include;

- outer reef drop off;
- lower and upper outer reef slope;
- reef crest and edge (including spur and groove formation);
- subtidal and intertidal reef flat;
- beach rock and sand rubble beach;
- Island;
- beach rock and sand/coral rubble beach;
  intertidal and subtidal reef flat;
- lagoon reef edge;
- lagoon reef slope; and
  lagoon proper.

The morphological reef areas associated with the Jaluit dock and Wotje dock and ramp include the marine habitats associated with the inshore lagoon environments including the beach rock and sand/coral rubble beach; intertidal and subtidal reef flat and lagoon proper whilst the Arno dock includes the marine habitats associated with the inshore seaward side environments including beach rock and sand rubble beach and intertidal and subtidal reef flat. The dock does not extend further into the marine habitats associated with the reef edge/crest and slope.

2.4.1 Threatened and Protected Species

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species records 3,248 species from 331 families and seven phyla listed as potentially occurring within the west Pacific marine region. This includes eight species that are critically endangered (facing an extremely high risk of extinction in the wild) including two sharks, one turtle, two sawfish, one stingray, one coral and one type of mangrove and 43 that are endangered (facing a very high risk of extinction in the wild) including sharks, rays, wrasses, sea snakes, sawfish and the green turtle (*Chelonia mydas*). Some 290 species are also listed as vulnerable and 234 as near threatened. These include several species of sharks and rays, sea snakes, whales, marine turtles (including hawksbill, leatherback and loggerhead) and corals from the families Acroporidae, Agariciidae, Dendrophylliidae, Euphyllidae, Faviidae, Helioporidae, Milleporidae, Mussidae, Oculinidae, Pocilloporidae, Poritidae and Agariciidae.

The RMI is reported to have a total number of 5812 flora and fauna of which 1524 are native species (26.1%) with the majority of the nation's land native species are crabs (e.g. hermit crabs *Coenobita sp*.). The coral reefs of the nation host 342 hard coral species and 880 fin fish species have been recorded.

Endemism is low recording 57 species in total throughout the nation, only 4 species have been assessed by the IUCN of which three are endangered and one is extinct. Eniwetok atoll has eight endemic species, Arno and Kwajalein have four and Ailinglaplap, Bikini, ebon, Jaluit and Rongerik atolls have one species.

A number of endemic species have been recorded includes the rare Pacific elkhorn (*Acropora palmata*) hard coral species only found to date on Arno atoll from one section of the outer reef approximately 2 km in length within 2-3 m of water. This reef site this species has been located is adjacent to the existing Arno dock, however the reported site is at a minimum 100 m from the dock.

The IUCN Red list categorizes 2,131 species within the RMI, including one (1) Critically Endangered (CE) species (Hawksbill Turtle - *Eretmochelys imbricata*), twelve (12) Endangered (EN) species, 88 vulnerable (VN), 123 Near Threatened (NT), 3 Lower Risk (Conservation dependent), 70 Data Deficient (DD) and 835 of Least Concern (LC). Table 1 provides the list of critically endangered and endangered species for the nation.

The RMI government recognizes 61 species or subspecies to be considered for conservation within the nation. This incudes;

- 13 nationally endangered or critically endangered species (five marine mammals, three birds, and five marine reptiles: one being critically endangered – hawksbill turtle).
- 5 are vulnerable species – one bird, one shark, three arthropods, (*Tridacna gigas* and *T. derasa*) giant clam species, and the Triton's shell (*Charonia tritonis*) – and one extinct species, the Wake Rail (*Gallirallus wakensis*).

The 18 threatened species represent 31% of total species considered for conservation within the RMI. The other 43 species are listed as Near Threatened, Low Risk or (with conservation measures), Data Deficient or Least Concern. The RMIs threatened species list includes the endangered, vulnerable and critically endangered – species, and most are found in the marine environment, with terrestrial plants making up just 0.5%.

The RMI government takes the threatened species issue seriously and has made initiatives to establish legislation to protect 19 endangered species: 18 are marine and one terrestrial species. Other threatened species are protected by individual atoll local government jurisdictions. The local governments set the restrictions on land and near-shore marine resources, which include the conservation of biodiversity. The Marshall Islands Marine Resources Authority (MIMRA) provides advice and technical assistance to local governments.

Four marine turtle species are native to the RMI, including the Leatherback (*Dermochelys coriacea*) and Olive Ridley (*Lepidochelys olivacea*), which are considered vulnerable; the Green Turtle (*Chelonia mydas*), which is considered endangered, and the Hawksbill Turtle (*Eretmochelys imbricata*), which is critically endangered. In addition, seventeen cetacean species are listed by the IUCN as being found in the waters of the RMI including the sperm whale (*Physeter macrocephalus*), which is considered to be vulnerable.

Table 1: Critically endangered and endangered species of the RMI as identified by the IUCN (2018).

Species	Common name	Red List Categorization
Eretmochelys imbricata	Hawksbill Turtle	Critically Endangered
Chelonia mydas	Green Turtle	Endangered
Holothuria nobilis	Black Teatfish	Endangered
Holothuria whitmaei	Black Teatfish	Endangered
Thelenota ananas	Prickly Redfish	Endangered
Cheilinus undulatus	Giant Humphead wrasse	Endangered
Stegostoma fasciatum	Zebra Shark	Endangered
Megaptera novaeangliae	Humpback Whale	Endangered
Isurus paucus	Longfin Mako	Endangered
Isurus oxyrinchus	Shortfin Mako	Endangered
Rhincodon typus	Whale Shark	Endangered
Emoia boettgeri	Micronesia Forest Skink	Endangered
Perochirus ateles	Dumeril's Tropical Gecko	Endangered

2.4.2 Marine Management

The RMI has been active in the management and protection of its marine and terrestrial resources through a government, traditional owner and community partnership. This is regulated by the Protected Areas Act (2015) and updated Regulations (2020) which has resulted in a Protected Area Network (PAN) system which is housed within MIMRA. The function of nations PAN is to expand on past management and protected area interventions to ensure a sustainable and resilient nation, where natural and cultural resources are effectively management and conserved for the future generations. There are four types of PAN protected areas these include;

a) **Type I – Subsistence only.** This area is managed for subsistence non-commercial use. In international standards – this relates to the IUCN Category VI – Managed Resources Protected Area.
b) **Type II – Special Reserve.** This area is subjected to a high level of protection, and occasionally a very low level of subsistence or special occasional activity. In international standards – this relates to the IUCN Category Ib –Wilderness Area. E.G are the atolls of Ailinginae and Bikini that have high levels of protection and restriction on human activities.
c) **Type III – Restricted and Protected Area.** This area has total restriction subject to np activities, either within a large protected area or in an identified protected area.
d) **Type IV - Traditional Mo.** This area includes either parts of land, a whole island, or a reef area that is managed and restricted through the practices of Mo by chiefs (Iroij) only.

15 atolls within the nation are currently managed under the PAN (Table 2). This includes the project atolls of Arno and Jaluit. In addition, several atolls including Wotje are currently working with the communities and traditional owners to finalise their atoll specific protected areas. Wotje atoll's protected area is proposed as a Conservation Area. Similarly, Jaluit atoll protected area, the first atoll to have had protected areas developed within the nation is currently undergoing discussions to possible updates to the existing atolls protected areas. Jaluit atoll current protected areas are discussed herein.

In total, 5388.4 km^2 and 33.59 km^2 marine and terrestrial areas respectively are protected within the RMI, equating to 0.27% and 11.9 % of total marine and terrestrial areas respectively. In addition, since 2010 the RMI has declared all marine waters to be a shark sanctuary prohibiting shark fishing and the release of all shark bycatch.

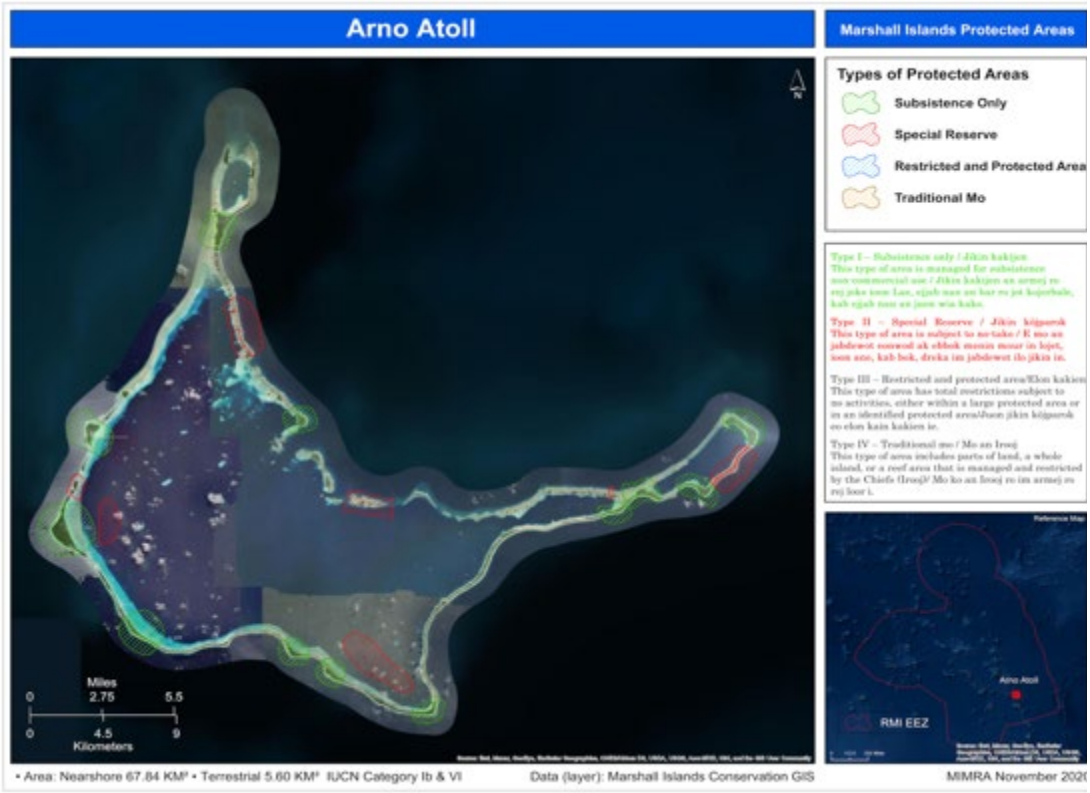
Table 2: RMI Protected Area list.

Atoll	Designation	Reported Area km^2	Reported Marine Area km^2	IUCN Category
Bikini	Conservation Area	2,120.8	2,032.87	Ib
Ailuk	Conservation Area	25.13	24.11	VI
Rongelap	Conservation Area	2,912.76	2,787.48	VI
Namdrik	Conservation Area	26.59	16.19	VI
Rongerik	Conservation Area	1,047.87	1,002.38	VI
Jaliut	Conservation Area Ramsar site	201.93	197.42	VI
Mili	Conservation Area			
Bokaak	Other Area	106.97	0	Ia
Kwajalein	Conservation Area	7.77	7.77	Ib
Bikar	Other Area	56.31	0	Ia
Ailinginae	Conservation Area	1,086.58	1,024.74	Ib
Majuro	Conservation Area	2.83	0	Ib
Namdrik	Ramsar Site – Wetlands	26.59	16.19	?
Arno	Conservation Area	71.45	62.25	VI
Likiep	Conservation Area	0.32	0.31	VI

Arno atoll protected area (Plate 4) includes 67.84 Km^2 and 5.6 km^2 for nearshore and atoll marine and terrestrial resources, respectively. All four types of protected areas are included in the atoll's management and protection plan, which include Type 1 – Subsistence Only, Type II – Special Reserves, Type III – Restricted and Protected Area and Type 4 – Traditional "Mo".

None of the protected areas are within or in close proximity to the Arno dock. However, a Type I designated nearshore marine and terrestrial area is located approximately 500 m to the north of the dock. A type II designated lagoon marine area is located approximately 800 m to the north of the dock, this area is within the lagoon. Both designated protected areas are well outside the direct and in directed areas of influence of the project with the type II designated site within the lagoon and as such will have no impacts from the projects scope of works.

Plate 4: Arno Atoll Conservation Area.



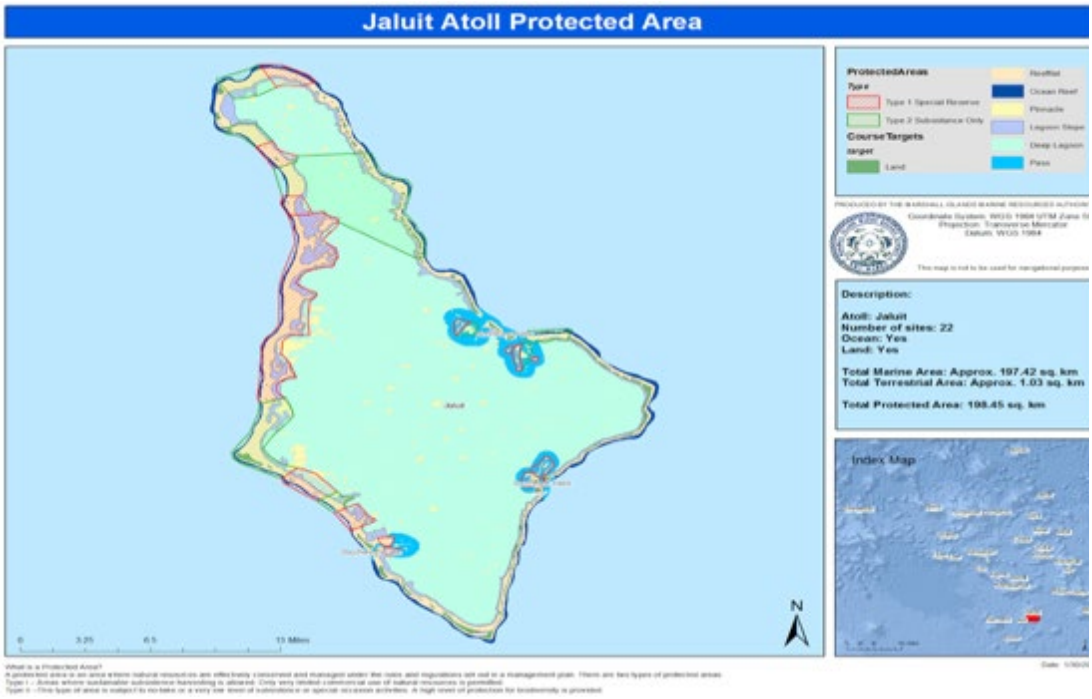
Jaluit atoll protected area (Plate 5) includes 197.42 km^2 and 1.03 km^2 for nearshore and atoll marine and terrestrial resources, respectively. Two types of protected areas are included in the atoll's management and protection plan, which include Type 1 – Subsistence Only, Type II – Special Reserves[1].

Jaluit atoll is a RASMAR site (Jaluit atoll Conservation Area) designed due to significant mangrove communities (the largest in the nation) and habitats for endangered and vulnerable marine resources and as such has critical habitats. The protected areas have been developed to ensure protection for these species and habitats.

There are no protected areas are within or in close proximity to the Jaluit dock. However, a Type II designated nearshore marine and terrestrial area is located approximately 850 m to the north of the dock. This designated protected area is well outside the direct and in directed areas of influence of the project and as such will have no impacts from the projects scope of works.

[1] NOTE: The categorization of protected area types have changed since the original designation for Jaluit atoll, the new categorization is reported herein.

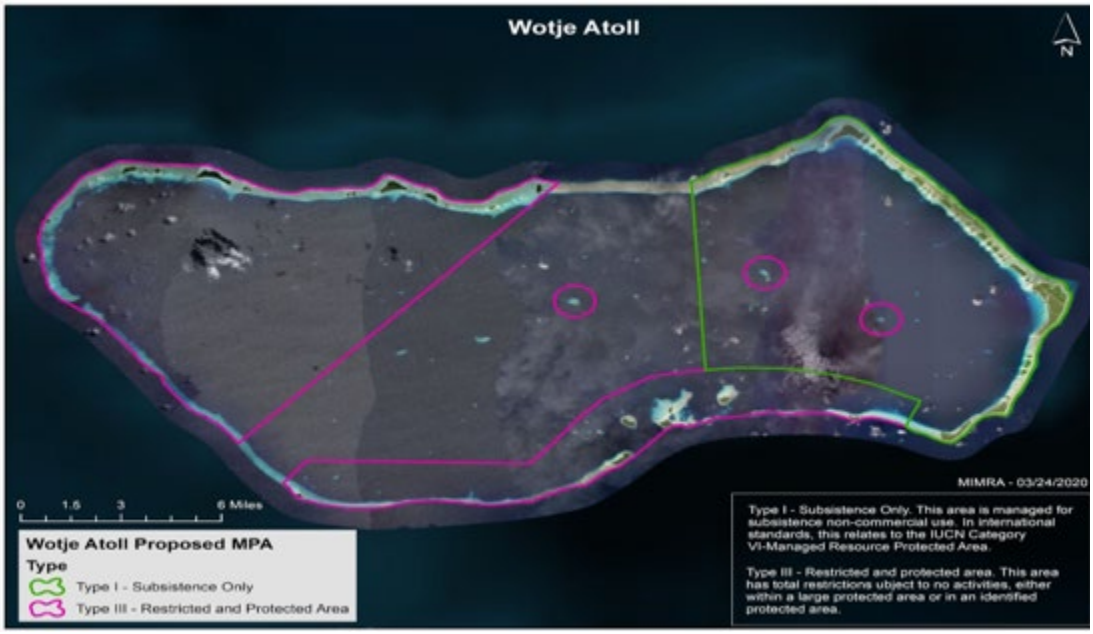
Plate 5: Jaluit Atoll Conservation Area.



Wotje atoll proposed protected area (Plate 6) includes two types of protected areas are included in the atoll's management and protection plan, which include Type 1 – Subsistence Only and Type III – Restricted and Protected Areas. Actual dimensions of each proposed protected area have yet to be finalized, however Plate 5 provides the proposed protected area allocations.

None of the protected areas are within or in close proximity to the Wotje dock or ramp, with the closest protected area designation over 7.7 km to the west. Both designated protected areas are well outside the direct and in directed areas of influence of the project and as such will have no impacts from the projects scope of works.

Plate 6: Wotje Proposed Atoll Conservation Area.



2.5 Marine Baseline Assessment

A marine biological baseline assessment was undertaken on the coastal and marine biomes associated the intertidal and shallow subtidal marine habitats and benthic substrate directly associated with the shallow water marine docks and ramp upgrades within Arno, Jaluit and Wotje atolls. This information provides the biological baseline data for the background, discussion and conclusions sections in the body of the project Environmental and Social Management Plan (ESMP) associated with the RMIMIP (WB P161382)

The marine assessment data collection was undertaken during the months of June and July 2023 for all atoll sites using free diving (snorkeling) and Self Contained Underwater Breathing Apparatus (SCUBA) qualitative and quantitative benthic habitat and resource assessment scientific visual survey methods.

In total, one free dive site was undertaken for the dock in Arno, Jaluit and Wotje each whilst an additional free dive was undertaken for the ramp in Wotje atoll and are describe in separate result and discussion sections below. The free dives included the marine benthic abiotic and biotic habitats and resources surrounding the docks and ramp (direct areas of influence) and have been analyzed as one data set per atoll to provide a comprehensive marine description of the benthic marine ecosystems associated with the project sites.

The assessments included documentation (photographic and video) of the shallow water benthic habitats including the shoreline and inshore intertidal and subtidal marine ecosystems at all assessment locations. All assessments were undertaken during day light hours.

2.6 Methods

The marine resource and ecological assessment data set (photographic and video) for each project site was collected by a New Zealand based professional commercial diving service (Underwater Solutions) under the guidance of the projects marine ecologist. The marine ecologist was not on site and as such all data collected, analyzed and presented herein is based on the data set provided by Underwater Solutions. It is noted that the project marine ecologist (Mr. Lindsay – Integrated Aquatic Solutions) has previously visited all marine sites within the project, albeit previously 15 plus years and as such has a full appreciation of the marine benthic abiotic and biotic resources associated with all project sites.

Free diving (snorkeling) and SCUBA scientific visual survey methods were employed to assess and provide a general description of the shallow intertidal and subtidal reef flats systems, associated with the docks and ramp site locations. The marine assessments in water field activities were completed in a single day for each of the three atoll sites. Table 3 provides the date for the individual site location assessment.

Table 3: Date of Marine Assessment of each Atoll site.

Dock Ramp Site Location	Assessment Date 2023
Jaluit Atoll	Wednesday 28th of June
Arno Atoll	Friday 02nd of July

Wotje Atoll	Saturday 29th of

The marine assessment included a qualitative and quantitative habitat and resource assessment based on the data set provided of the existing coastal intertidal and subtidal marine environments directly surrounding each dock/ramp locations including the extended area of influence of the projects scope of works.

Data collected included water depth, percent live coral cover, reef condition, dominant benthic forms, dominant hard coral genus and morphological forms, marine algae (turf, macro), seagrass, sediment types and physical description including water movements/currents. Digital photos and videos were taken of each site in full and key biological features (biotic and abiotic) and a Global Positioning System (GPS) coordinates recorded for each assessment location coastal reef system assessed.

Previous published reports associated with the marine environments of the RMI, specifically the individual atolls and site locations were reviewed and used for baseline data comparisons and references where available. The project's Environmental and Social Management Framework (ESMF) marine summary assessments for Jaluit atoll was reviewed. Arno and Wotje atoll sites were not assessed during the preparation of the projects ESMF.

In total, four (4) Free dives (snorkeling and SCUBA) were undertaken during the assessment and included the intertidal and subtidal coastal shoreline and associated reef systems for each dock and ramp. Figures 2, 3 and 4 provides the assessment areas for Arno, Jaluit and Wotje atoll sites, respectively.

Figure 2: Free Diving site assessed for Arno dock during the marine benthic assessment.

Figure 3: Free Diving site assessed for Jaluit dock during the marine benthic assessment.

Figure 4: Free Diving site assessed for Wotje dock and ramp during the marine benthic assessment.

The area assessed differed between each Free Dive site undertaken at each of three atolls. Total assessed areas for the docks at Arno, Jaluit and Wotje was 5,070 m^2, 1,417 m^2 and 15,330 m^2 respectively, whilst an additional 31,157 m^2 was undertaken associated with the Wotje ramp. In total an area of 52,974 m^2 (5.2 hectares) was undertaken for all sites. Water depth varied between atoll sites and includes <1-4 m, <1-5 m and ,1–3 m for Arno, Jaluit and Wotje sites respectively.

3.0 Marine Site Description and Marine Benthic Results

This section details the baseline survey results for the marine benthic abiotic habitat and biotic resource (intertidal and subtidal) assessment undertaken for the three project sites and associated docks and ramp (Wotje atoll only). The assessment results and discussions are divided into three separate sections based on the project sites (atolls) and include both the projects direct and indirect area of influence anticipated from the construction phase of the project. All marine areas outside of the areas assessed for all three atolls are anticipated to have no impacts to the marine biotic and abiotic resources from the scope of works associated with the docks and ramp refurbishments.

The projects Direct Area of Influence includes all marine areas that are anticipated to receive impacts directly associated with the individual project scope of works. Physical impacts to the benthic marine resources and substrate for all sites are restricted to the small marine areas directly adjacent to the existing dock/ramp structures. Impacts associated with potential elevated suspended sedimentation resulting from the works at all sites are expected to be minor to very minor, dispersed quickly on the diurnal tidal currents associated with all sites and will impact only sessile flora and fauna in close proximity to the sediment dispersal area at all sites.

3.1 Arno Atoll Dock

Arno Dock (7^{0}02’55.27”N and 171^{0}33’54.96”E) is situated on a seaward intertidal shoreline in the south-western end of the island of Arno (refer Plate 1). The dock is directly attached and accessible to the shoreline through past reclamation activities and extends approximately 75 m (west) across the fringing reef. The dock has a single berth with a concrete top and stairs on the eastern side providing access to the water level. At the landward end of the dock there is a building approximately 12 m x 15 m and a small landing ramp (20 m) to the south. The area directly south and adjacent to the dock has been dredged to create the berth basin with material used to backfill accessways to the dock and surrounding land (refer Figure 2). The intertidal reef flat directly north of the dock has had limited physical impacts form past construction however high siltation derived from the berth pocket has negatively impacted the reef benthic communities. Vessels utilize the western side of the dock where the water is deepest due to past significant seabed dredging. A single lane coralline gravel road provides access from the dock to the nearby village.

Past reclamation activities associated with the Arno dock and associated ramp has altered the coastal foreshore and significantly altered the intertidal and subtidal reef flat (the dredged area directly adjacent and south of the dock), changing localized marine water dynamics and circulation patterns within and around the dock. Significantly higher levels of sedimentation (calcium carbonate) are recorded directly to the south of the dock within the berth pocket (dredged site) with considerable suspended sedimentation being discharged west of this site onto the outer reef areas resulting in significant mortality of sessile marine invertebrates (e.g. hard corals). The land area directly adjacent to the ramp is currently being used to stock pile marine sediments (Plate 7). It is assumed the marine sediments have been acquired from the neighboring lagoon and transported to the site using the ramp.

Plate 7: Stock pile of marine sediment adjacent to the Arno dock and ramp.

A coastal seaward coral reef and associated benthic resources are located adjacent to the shoreline associated with the Arno dock. In general, the marine benthic abiotic habitat and biotic resources throughout the area reflect a functioning marine ecosystem that has adapted to the past and current physical alterations. The southern areas adjacent to the Arno dock have been significantly altered due to past dredging activities and usage of the dock.

There is a paucity of benthic fauna resource diversity and population densities next to and adjacent to the dock, whilst benthic flora (macroalgae) record higher population densities, albeit low diversity in areas where hard benthic substrate has been removed.

The reef abiotic benthic systems associated with the dock site are similar throughout the area assessed and are characterized by an extensive sand beach (calcium carbonate in origin) including a rubble shingle bank towards the land and underlining beach rock, an expansive shallow intertidal reef flat that is significantly exposed during low tide events that extends the full length of the dock, a small linear subtidal reef flat that terminates in the outer reef edge/crest and reef slope which descends vertically to the sea floor into open oceanic water. The southern side directly adjacent to the dock has been dredged along its entirely and as such the intertidal reef flat has been highly modified (removed) in this areas.

Arno dock impacts and is directly located on the reef morphological areas includes the marine habitats associated with the inshore seaward fringing reef environments including beach rock and sand rubble beach and the intertidal reef flat. The dock does not extend further into the marine habitats associated with the subtidal reef flat, outer reef subtidal reef flat, reef edge/crest and slope.

There are no sea grass, mangrove trees nor rivers/streams entering the coastline in close proximity to the dock site. During periods of high rainfall anecdotal information suggests that underground natural freshwater springs are located along the coastal beach adjacent to and in close proximity to the dock. Low levels of anthropogenic rubbish were located in the waters surrounding the dock.

A foreshore beach is the dominate feature to the north and to a lesser degree south of dock due to foreshore reclamation activities, including the ramp and dock wall development. The beach is composed of reef derived (calcium carbonate) sand, rubble and small rocks, which have a distinct shingle bed toward the upper foreshore on the

north side of the dock, ranges in width between 8-20 m, water depth fluctuates with the tide <0.5 m) and is exposed during low tide and rest directly on top of the beach bedrock (Plate 8).

Plate 8: Beach adjacent (a) north and (b) south of the Arno dock.

The seabed substrate adjacent to the dock is relatively homogenous throughout the assessment site and is characterized by a bottom layer of coarse calcium carbonate sand derived from coral reef and foraminifera origins located on a hard reef benthic base layer. This continues onto the reef edge and crest outside of the docks direct impacts. Significant finer sand/silt deposition are recorded within the dredged reef section directly south of the dock with fine suspended sediments discharged directly west onto the subtidal and outer reef areas.

Water turbidity and resulting water clarity surrounding the dock varies, with the northern side of the dock similar to waters located along the natural shoreline, whilst water associated with the southern side of the dock record high turbidity levels (low clarity), however fluctuations occur and are dependent on tidal height, water currents and weather conditions. The sediments located south of the dock significantly impact the water quality associated with the project site and have a direct impact on the benthic coral reef biotic resources.

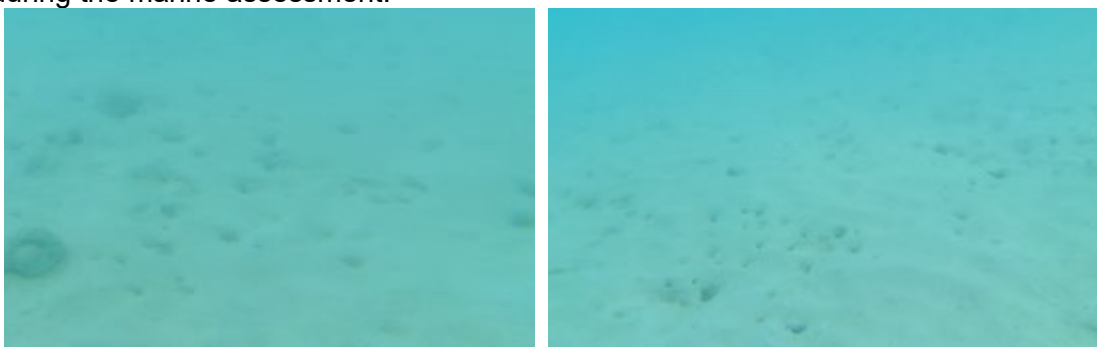
Reef derived rocks, boulders and gravel were recorded throughout the area assessed with considerable percentage coverage in close proximity and associated with the southern areas (dredged site) of the dock. Plate 9 provides representative photos of the benthic abiotic substrate located (a) north and (b) south of the Arno dock.

Plate 9: Representative photos of the benthic substrate associated with the intertidal reef flat (a) north and (b) south of Arno dock.

Exposure during low water and the high level of suspended sand based silt/substrate (refer Plate 9) located in the north and south respectively of the dock has a significant detrimental effect on recruitment and survival of sessile benthic marine life. This has resulted in a paucity of sessile and mobile benthic invertebrate species throughout the areas assessed adjacent to the Arno dock.

A health population of the marine sedentary peanut worm (polychaetes – *Sipuncula sp.)* burrows were recorded within the sediment located within the southern dredged sites (Plate 10). These resources are mobile and can adapt to changes and/or disturbance in the benthic sediment profile.

Plate 10: Marine invertebrate polychaete burrows located south of the Arno dock during the marine assessment.



The Arno dock in its entirety has been constructed directly onto the intertidal reef flat, with access through the foreshore beach. The intertidal reef flat adjacent to and running parallel to the Arno dock in the north has an extensive linear width of approximately 90 m, averages less than 0.5 m in water depth (tidally influenced) and is exposed to a large extent during low tide periods (refer Figure 2).

The intertidal reef flat directly south of the Arno dock has been physically removed due to past dredged operations, resulting in an area of approximately 3,000 m^2 extending the full length of the dock (Figure 5). The dredged area has an average depth of 3m, vertical dredged walls and allows water access to the Arno ramp located directly south of the dock. Anecdotal information indicates that the dredged material was used to construct the dock, ramp and associated foreshore reclamation activities. This benthic substrate throughout the dredged area is all but devoid of benthic sessile biotic resources. Hard coral and marcoalgae were recorded on the vertical walls and on substrate not physically altered due to the past dredging activities.

Figure 5: Location of the dredged area associated with the Arno dock.

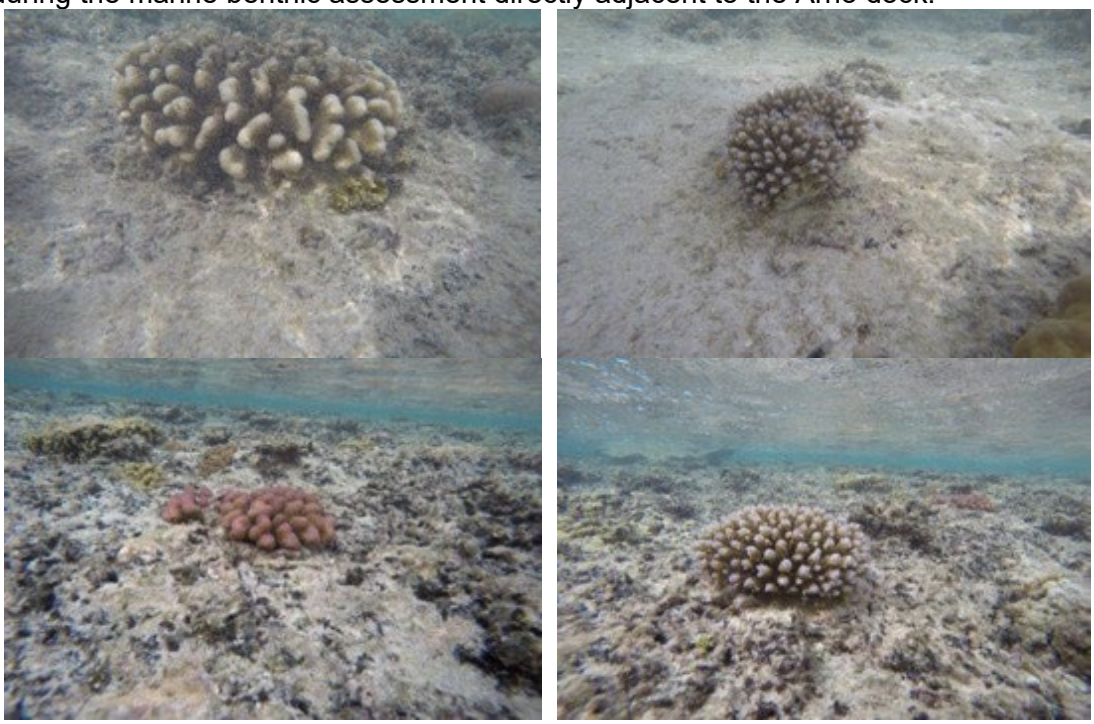
The intertidal reef flats on both sides of the Arno dock are predominately bare of hard corals throughout the area assessed due to daily exposure in the intertidal zone and unsuitable water conditions for recruitment, growth and survival.

Hard coral percentage coverage on the northern side of the Arno dock is very low averaging far less than 1% coral coverage, whilst hard coral coverage on the southern side of the dock is sporadic and ranged between <1–20 % coverage. Exposure and sedimentation (especially in the south) are the determination factor reducing hard coral coverage in both the northern and southern sites, however due to the past dredging operations increase hard surface habitat in the south of the dock has been created (dredged site walls) allowing for hard coral recruitment and subsequent survival.

Isolated hard coral colonies, predominately *Porities sp. Acropora sp., and Pocillopora sp*., were recorded attached directly to the intertidal reef substrate (predominately northern side of the dock), dredged site vertical walls and/or elevated hard substrates and/or to a much lower percentage attached to the dock wall (Plate 11).

Hard coral species diversity is relatively low with morphological forms (size, structure) throughout the sites assessed relatively homogenous and reflects the ecosystem parameters within the area. Hard coral small sub massive (e.g. *Porities sp.*), digitate (*Porities sp*., and *Pocillopora sp*), branching (e.g. *Acropora sp*., and *Pocillopora sp.*) and encrusting (*Porities sp*. and *Monitipora sp*.,) hard corals (refer Plate 11) were the dominate morphological forms located throughout the assessed area.

Plate 11: Representative photos of hard coral colonies located (a) north and (b) south during the marine benthic assessment directly adjacent to the Arno dock.

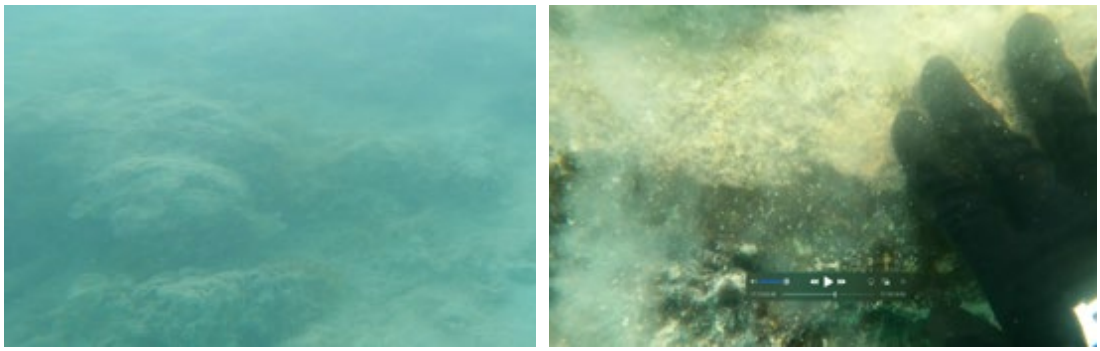


A large number of hard coral colonies located on or in close proximity on the southern side of the Arno dock recorded signs of stress due to high levels of suspended sediments, with significant hard coral mortality recorded throughout the area (Plate 12). There was a notable absence of large coral heads, table corals of any size and sea anemones at all sites assessed. There were no soft coral colonies and/or individuals located within these zones.

Evidence of hard coral recruitment was recorded, with a small number of coral colonies (e.g. *Pocillopora sp*. and *Porities sp.)* located on the reef flat north of the dock and on the hard substrates associated with the wall of the dredged site and dock wall in the south. Thus providing direct evidence of natural hard coral recruitment is active in these areas, albeit in low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habitat and resources.

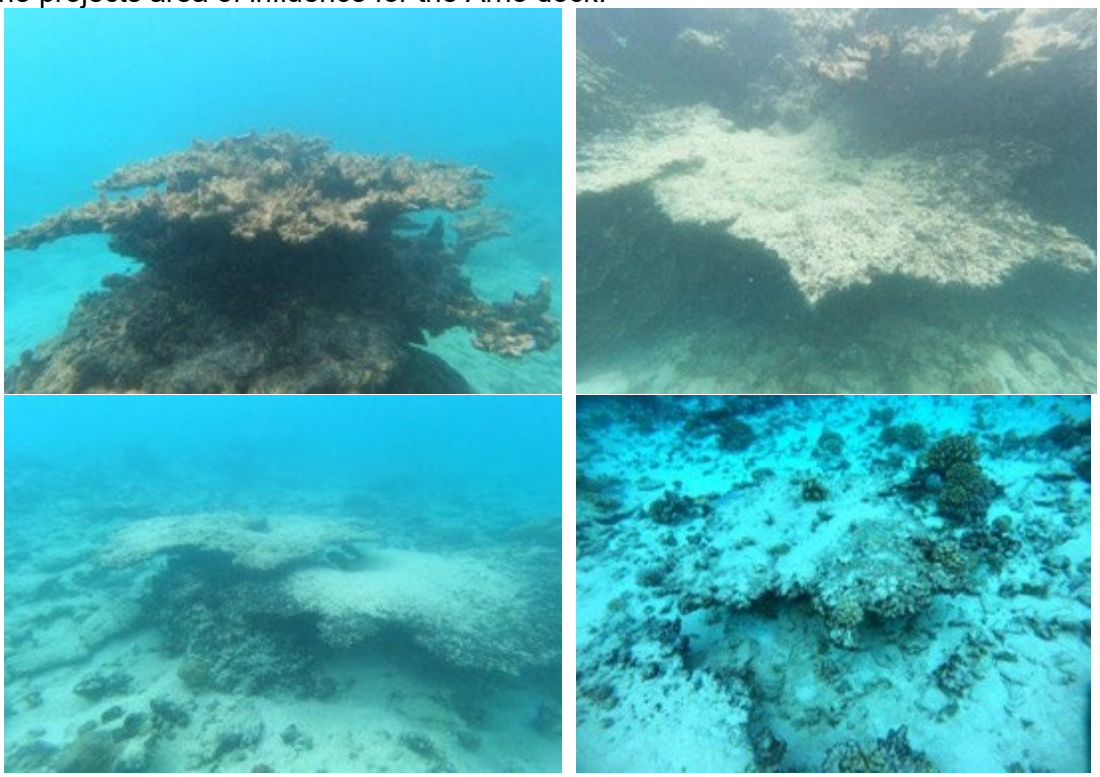
There was no evidence of hard coral disease (e.g. bacteria or virus), the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.*

Plate 12: Hard coral mortality and stress resulting from high levels of suspended sediment recorded south of the Arno dock.



The reef system (subtidal reef flat, reef edge and crest and outer reef slope) directly west of the dock are well outside the area of influence of the projects scope of works recorded significantly higher hard coral percentage coverage and species diversity than recorded for the marine biomes to the north and south of the Arno dock. This higher level of diversity and percent live coverage is expected due to the environmental habitats associated with these ecological systems. However, it is noted that high levels of sedimentation were recorded throughout the subtidal reef flat extending through to the reef edge and crest and into the upper reef slope directly adjacent to the Arno berth pocket (original dredged site). These elevated levels of suspended sediment has resulting in elevated mortality levels of hard corals over an extended area and period of time (Plate 13). This mortality is unacceptable and urgent sediment mitigate and management measures need to be developed and implemented at the Arno dock and surrounding area to prevent further negative impacts on the marine environment and its resources.

Plate 13: Hard coral mortality recorded on the reef system to the west and outside of the projects area of influence for the Arno dock.



The brown algae *Padina sp.* and *Dictyota sp*., the green algae *Halimeda sp*., and the red algae's *Laurencia sp.* and crustose coralline algae (Plate 14) were the dominate macroalga recorded throughout the sites assessed. Macroalgae percent coverage was highest on the southern side of the dock, ranging between <5 – 50 % coverage of the above species. The northern intertidal substrate had a range of macroalgae coverage between <5 - 30%, water level was the determining factor with the crustose coralline algae recorded the highest density and percent coverage.

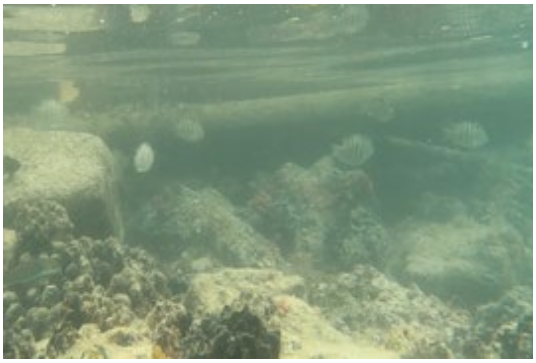
Plate 14: Macroalgae, (a and b) *Padina sp.* (c) *Dictyota sp.,* and (d) *Halimeda sp*., located within the intertidal reef flat directly north and south of the Arno dock.

There was a paucity of invertebrate sessile animals on both sides of the Arno dock with very limited numbers of mollusks (e.g. bivalves, gastropods, cephalopods), echinoderms (sea cucumbers) and crustaceans (e.g. crabs, crayfish) located. Several species of marine intertidal gastropods (Mollusca) were recorded associated with the northern sites assessed (e.g. *Nerita. sp*.), several *Trochus niloticus* were located directly west of the dock and the short spine black sea urchin (*Diadema sp.)* was located on both sides of the dock. The shoreline crab (*Pachygrapsus sp.)* was recorded associated with the docks revetment wall on the southern side of the dock (Plate 15). There was no evidence of the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.* The absence of these resources is a direct result of the marine conditions prevailing at this site preventing recruitment and survival and anthropogenic usage (fishing pressure) of the resources.

Plate 15: Marine resources, gastropod snails (a) *Nerita sp.,* and (b) *Trochus niloticus* sea urchin (c) *Diadema sp.,* and crab (d) (*Pachygrapsus sp*.) located within the waters directly adjacent to the Arno dock.

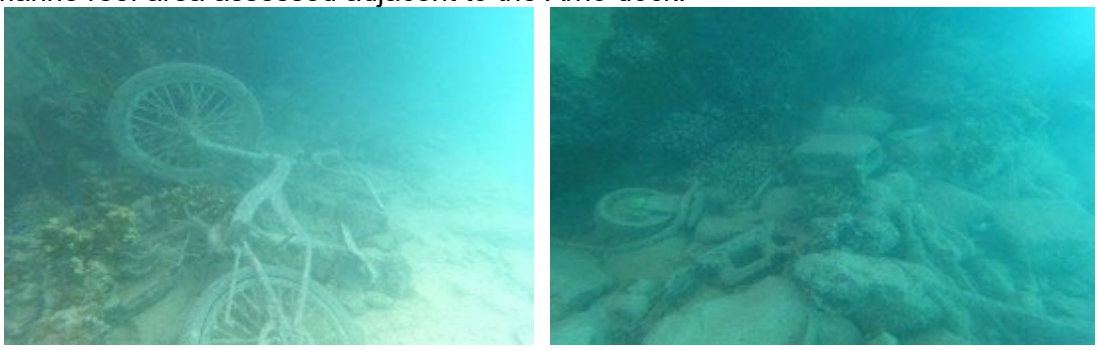

Finfish population numbers and species diversity were low either side of the Arno port, with considerable increases in both species diversity and densities associated with the outer reef ecological systems west of the port. The absence of fish during the survey may be attributed to the time of the assessment and/or tidal height, restricted habitat availability (relevant to the north intertidal reef flat) and/or it may be a direct result of fishing pressure. Finfish species that were identified during the assessment were dominated by reef dwelling plankitvores (e.g. Pomacanthidae), corallivorous (butterfly fish – *Chaetodon sp.)* and herbivores (e.g. Acanthuridae, Scaridae) (Plate 16). Anecdotal information indicates that during high tide periods significant schools of "baitfish" (most likely scads) are located on the southern side of the dock which are subsequently preyed on by a range of tropical predator fin fish (e.g. Trevallies, Barracuda etc).

Plate 16: Marine finfish located within the reef areas directly adjacent to the Jaluit dock.

The marine benthic environment associated with the dock contained a small amount of anthropogenic used material and machinery (Plate 17) of which most was located on the southern side of the dock. A benthic physical cleanup of this material is recommended.

Plate 17: Anthropogenic garbage located during the marine assessment within the marine reef area assessed adjacent to the Arno dock.



Key Findings of the Arno Marine Assessment

The upgrading of the Arno dock does not impact any marine, coastal or terrestrial conservation and/or protected area, sites of cultural, customary or heritage significance nor any national or international marine, freshwater or terrestrial endangered or protected species. Thus no impacts on critical habitats are associated with this project.

The key findings of the shallow water marine benthic assessment of the Arno dock upgrade project include:

- The intertidal seabed substrate associated with the existing Arno dock is relatively homogenous and similar throughout the area. The substrate is characterized by hard reef bed rock substrate covered with a bottom layer of coarse sand, gravel and rocks derived from coral reef origins.
- The benthic substrate to the north of the dock has had little physical alteration however the intertidal reef flat that the dock has been built on and directly south has included sea floor dredging which has resulted in significant alteration and reclamation for the construction of the dock. Adjacent coastal foreshore and south of the dock, the beach and intertidal reef flat has been significant altered resulting in degradation of the benthic ecosystem habitat and function throughout the site assessed.
- The reef system within the projects direct and indirect Area of Influence to the north of the Arno dock includes a wide foreshore beach which has underlying beach bedrock (calcium carbonate) and an extensive intertidal reef flat that is significantly exposed during low tide events that extends the full length of the dock. The southern side directly adjacent to the dock has been dredged along its entirely and as such the intertidal reef flat has been highly modified in this area.
- High levels of suspended sediments and benthic siltation are recorded throughout the southern side of the dock.
- Hard coral percent live coverage, morphological form, diversity and abundance was similar within the site assessed reflecting the natural and anthropogenic environmental forces affecting the different reef locations. The dredged area directly south of the dock has significantly altered the benthic habitat and associated hard coral diversity and densities.
- Hard coral percentage coverage on the northern side of the Arno dock is very low averaging far less than 1% coral coverage, whilst hard coral coverage on the southern side of the dock is sporadic and ranged between <1–20 percentage coverage.

- Isolated hard coral colonies, predominately *Porities sp. Acropora sp., and Pocillopora sp*., were recorded attached directly to the intertidal reef substrate (predominately northern side of the dock), dredged site vertical walls and/or elevated hard substrates and/or to a much lower percentage attached to the dock wall
- No soft corals were recorded.
- Newly recruited hard coral colonies were located in very low numbers providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habit and resources.
- Coral species diversity and morphology remained similar in each of the reef zones throughout the assessment site.
- Hard coral small sub massive (e.g. *Porities sp.,*), digitate (*Porities sp*., *Pocillopora sp.*), branching (e.g. *Acropora sp., Pocillopora sp.*) and encrusting (*Porities sp*. and *Monitipora sp*.,) morphological forms dominated the reef systems assessed.
- Marine macro algae density, coverage and species diversity was relatively high recording a range between <5 -50 % and <5 – 30% coverage for southern and northern sides of the Arno dock respectively. Dominant species include the brown algae *Padina sp.* and *Dictyota sp*., the green algae *Halimeda sp*., and the red algae's *Laurencia sp.* and crustose coralline algae.
- No sea grass, mangroves nor rivers/streams were recorded within the assessed area.
- There were no threatened, endangered or endemic hard coral species, other invertebrate – vertebrate species located during the assessment for the reef systems adjacent to the dock.
- There were no marine mammals and/or marine reptiles (turtles) within or in close proximity to the dock.
- Finfish population numbers and species diversity was very low, however significant increasing were recorded to the west of the dock (well outside the projects area of impact) associated with the outer reef ecosystems. Species that were present were juveniles and include reef dwelling plankitvores (small fish), herbivores (e.g. Acanthuridae, Scaridae), corallivores (e.g. Chaetodondae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates were recorded at all assessed sites. Those that were recorded have little or no subsistence or commercial value.
- No Crown of Thorns (COTS), coral eating gastropod snails (e.g. *Drupella sp.)* or coral disease were recorded during the assessment.
- The marine benthic environment associated with the dock contains significant anthropogenic community derived garbage, a physical cleanup is recommended.
- The benthic substrate associated with the Arno dock due to its environmental characteristics and past coastal foreshore and intertidal reclamation/dredging activities, the benthic habitat within this area can be considered to have a low ecological habitat and value.

Key Environmental Impacts

The proposed scope of works to upgrade the existing Arno dock has a small environmental footprint both above and below the water level. Impacts on the marine environment and coastal waters within and around the dock are expected to be very

minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures.

There are no threats to the area's marine and coastal biodiversity associated with the project. The rare hard coral *Acropora palmata* (Pacific Elkhorn) was not recorded within the waters directly or indirectly associated with the Arno Port. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, easily mitigatable and overall insignificant.

The potential impacts of the project on the marine biological environment include:

- There is potential for localized and temporary increased suspended sediment levels in the marine environment around the dock as a result of the projects scope of works. Such impacts are expected to be very minor due to i) the low habitat value of the benthic environment, ii) prevailing tidal current persisting at the site, iii) site existing sedimentation and siltation conditions and iv) the limited physical construction activities proposed.
- The tidal current associated with this site will disperse fine sediment quickly.
- Spillage/leakage of oil and other pollutants into the marine environment from plant and equipment used during the construction phase of the project.
- Benthic habitats associated with the footprint directly adjacent to the existing Arno dock supports a very low hard coral intertidal and subtidal (southern side only) reef community that has been extensively degraded and altered due to past reclamation and construction activities. It is expected that a small number of hard coral colonies will be directly impacted by the projects activities, these losses will not be detrimental to the ecology of the site nor the species. The substrate between the hard coral is composed of sand/silt containing a paucity of benthic sessile invertebrates.

As such the benthic habitat and ecosystem associated with the project sites may be classified as an extensively modified and highly disturbed benthic foreshore and marine habitat of low ecological value. The proposed scope of works as such will have a negligible potential impact on these habitats, its resources and is acceptable.

Potential Impact Mitigation Measures

The potential impact of increased suspended sediment levels from the works can be further minimized through implementation of the following mitigation measures during the construction phase of the project:

- Ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the dock.

Due to the existing marine benthic environment and water circulation patterns associated with the Arno dock it is not recommended to use silt curtains during construction. The water current during tidal exchange will transport and allow suspended sediment to disperse throughout the adjacent waters significantly reducing potential sediment impacts on the live biota associated and surrounding the dock.

The contractor will be required to ensure all equipment is properly maintained and to follow all necessary precautions to prevent spillage of petrochemicals into the marine

environment. Provided such measures are properly implemented the potential impacts on the marine environment will be insignificant.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works. There is no biological justification to relocate hard coral colonies that may be impacted by the projects scope of works.

3.2 Jaluit Atoll Dock

Jaluit Dock ($5^0$55'12.89"N and $169^0$38'29.36"E) is situated on the leeward, lagoon intertidal shoreline in the south eastern corner of Jaluit atoll adjacent to the community of Jabor (refer Plate 2). The dock is directly attached and accessible to the shoreline through past reclamation activities which extend north (includes private houses and small commercial buildings) and south of the dock. The area directly south and adjacent to the dock foreshore has been dredged with material used to backfill accessways to the dock and surrounding land (refer Figure 3).

Past reclamation activities for the dock and surrounding areas have significantly altered the coastal foreshore, intertidal and subtidal reef flat and changed localized marine water dynamics and circulation patterns within and around the dock. Higher levels of sedimentation (calcium carbonate) are recorded to the north of the dock as shown by the existence of a small distinctive sand beach present during low tide and sand banks to the north.

A lagoon coastal coral reef and associated benthic resources are located adjacent to the shoreline associated with the Jaluit dock. In general, the marine benthic abiotic habitat and biotic resources throughout the area reflect a functioning marine ecosystem that has adapted to the past physical alterations. There is a paucity of biotic benthic resource diversity and population densities next to and adjacent to the dock. The abiotic reef systems associated with the dock site are very similar throughout the area assessed and are characterized by a sand beach (calcium carbonate in origin) almost nonexistent in the south, a small shallow intertidal reef flat with underlining beach rock, a small subtidal reef flat that extends at a low vertical gradient into the lagoon. The Jaluit dock impacts and is directly located on the reef morphological areas including the coastal foreshore, beach rock, sand rubble beach, intertidal and subtidal reef flat, and lagoon itself.

There were no sea grass, mangrove trees nor rivers/streams entering the coastline in close proximity to the dock site. During periods of high rainfall anecdotal information suggests that underground natural freshwater springs are located along the coastal beach adjacent and in close proximity to the dock. Significant anthropogenic garbage was located in the waters surrounding the dock.

The small foreshore beach is a dominate feature to the north of the dock, whilst it is all but nonexistence south due to the past dredging activities and foreshore reclamation. The beach is composed of reef derived (calcium carbonate) sand and a considerably smaller rubble portion, ranges in width between 5-10 m, water depth fluctuates with

the tide and weather conditions (e.g. wave action) and rest directly on top of a beach bedrock (Plate 18).

Plate 18: Beach adjacent north (a) and south (b) of the Jaluit dock.

The seabed substrate adjacent to the dock is relatively homogenous throughout the assessment site and is characterized by a thick bottom layer of coarse calcium carbonate sand derived from coral reef and foraminifera origins. Finer sand deposition was recorded further into the lagoon and to the south of the dock.

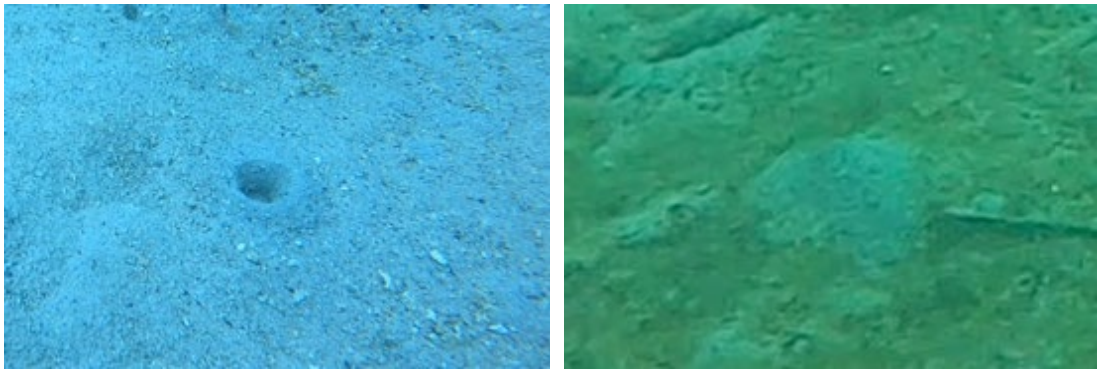
Water turbidity and resulting water clarity surrounding the dock remains average to low, however fluctuations occur and are dependent on tidal height, water currents and weather conditions. These sediments do impact the water quality associated with the project site and have a direct impact on the benthic coral reef biotic resources.

Reef derived rocks, boulders and gravel were recorded throughout the area assessed with considerable percent coverage in close proximity to the dock. Higher percent coverage of rock and gravel were recorded on the northern side of the dock with a significant numbers of concrete structures and bricks directly located next to the existing dock wall. It is presumed these have at some stage fallen away from the dock. Plate 19 provides representative photos of the benthic abiotic substrate located adjacent to the Jaluit dock.

Plate 19: Representative photos of the benthic substrate associated with the Jaluit dock.

The relatively high level of suspended sand based substrate (refer Plate 19) located at all assessment sites and the lack of hard benthic structures (rocks, reef etc) that are not covered in sand/silt has a significant detrimental effect on recruitment and survival of sessile benthic marine life. This has resulted in a paucity of sessile and mobile benthic invertebrate species throughout the area (significantly reduce hard coral were recorded – refer below). Nevertheless, small numbers of marine sedentary peanut worm (polychaetes – *Sipuncula sp.)* burrows were recorded in the lagoon sediments adjacent to the dock, however population densities were low (Plate 20). These resources are mobile and can adapt to changes and/or disturbance in the benthic sediment profile.

Plate 20: Marine invertebrate polychaete burrows located during the marine assessment associated with the Jaluit dock.

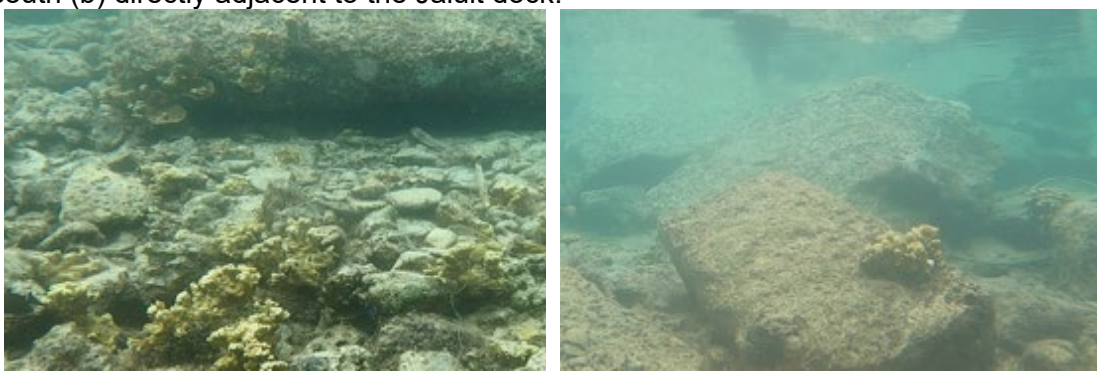


The intertidal reef flat adjacent to and running north and south of the Jaluit dock, has a small linear width, ranging between 2 - 4 m, average less than 0.5 m in water depth (tidally influenced) and is exposed in small isolated sections (adjacent to the norther side beach) during low water. The subtidal reef flat is an extension of the intertidal reef flat and has also a small linear width of approximately 5 m, averages 0.5-1.5 m in water depth.

Directly south of the Jaluit dock, the intertidal reef flat have been dredged along the shoreline with the material dredged previously used for back fill associated with the dock and adjacent land. The dredged area is approximately 20 m wide, 1-2 m deep and 60 m in length. This area is all but devoid of benthic sessile biotic resources as a direct result of the past dredging activities (refer Figure 3).

The intertidal and subtidal reef flats on both sides of the Jaluit dock are predominately bare of hard corals throughout the area assessed due to daily exposure of the intertidal zone and unsuitable water conditions for recruitment, growth and survival. Isolated rare small hard coral colonies (*Porities sp.*) were recorded attached to elevated hard substrate and/or attached to the dock wall within the subtidal reef flat (Plate 21). There were no soft coral colonies and/or individuals located within these zones.

Plate 21: Representative photos of the intertidal and subtidal reef flat north (a) and south (b) directly adjacent to the Jaluit dock.




There was an absence of invertebrate sessile animals on both sides of the Jaluit dock within both the intertidal and subtidal reef zones with no mollusks (e.g. bivalves, gastropods, cephalopods), echinoderms (sea cucumbers) and crustaceans (e.g. crabs, crayfish) located. The absence of both sessile and sedentary invertebrates is a direct result of the marine conditions prevailing at this site preventing recruitment and survival. The absence of sea cucumbers (e.g. *Holothuria atra*) maybe also be a direct result of anthropogenic usage (fishing pressure) of the resources.

A paucity of fin fish was recorded during the assessment within the intertidal and subtidal marine sites, however anecdotal information reported that these reef zones are utilized by a wide range of fin fish species during periods of high water and as such are transitory in nature entering the zone for feeding. The majority of fin fish reported during the assessment are herbivorous including parrot (Scaridae), surgeon (Acanthuridae) fish, planktivores damsel (Pomacanthidae) and butterfly fish (Chaetodontidae). It is noted that no predator fin fish were recorded during the assessment.

The red algae *Laurencia sp.* (Plate 22) and the brown algae *Padina sp.* were the only macroalga recorded within this zone. The former only located within a small defined area to the north and adjacent to the dock in approximately 2 m of water whilst isolated small colonies throughout the area were located of the latter species. The paucity of marcoalgae is a directly related to the marine conditions within this zone.

Plate 22: Macroalgae, (a) *Laurencia sp.* (b) and *Padina sp.* located within the subtidal reef flat directly north and adjacent to the Jaluit dock.


The subtidal reef flat descends through a gentle slope directly into the shallow lagoon. Water depth at the interface is approximately 2m and depth continues to 6-8 m adjacent to the western end of the dock. There was no distinct reef crest or edge.

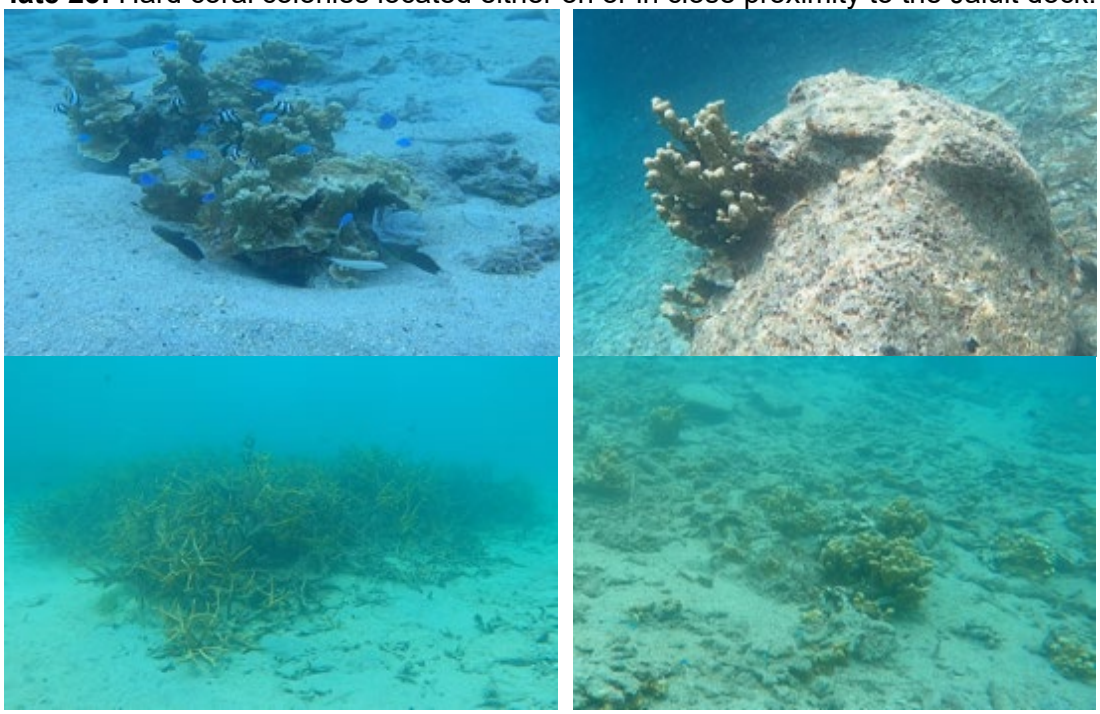
Hard coral live percent coverage was very low on both sides of the dock and was less than 1% coverage throughout the area assessed. Several small isolated patches of branching coral (e.g. *Acropora s*p) were located adjacent to the southern side of the dock in water depth of 2-3 m. These stands showed the highest percent hard coral coverage throughout the assessed site, however coral colony mortality was recorded for the majority of the corals that are in contact with the seafloor. Hard coral colonies were therefore sparce overall with less colonies recorded on the northern side than areas to the south directly adjacent to the dock.

Similarly, hard coral species diversity was very low with morphological forms (size, structure) throughout the sites assessed relatively homogenous, reflecting the ecosystem parameters within the area assessed. Hard coral small sub massive (e.g. *Porities sp., Monitipora sp.,*), digitate (*Porities sp*.), and branching (e.g. *Acropora sp., Pocillopora sp.*) hard coral colonies (Plate 23) were the dominate morphological forms and species located throughout the assessed area. All colonies recorded showed signs of stress (e.g. sedimentation) and there was a notable absence of large coral heads, table corals of any size and sea anemones at all sites assessed. There were no soft coral colonies and/or individuals located within these zones.

Evidence of hard coral recruitment was rare, with only a small number of coral colonies (Pocillopora sp.) located within the deeper water associated with both the sub tidal and lagoon sections directly adjacent to the dock. Thus providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habitat and resources.

There was no evidence of hard coral disease (e.g. bacteria or virus), the Crown of thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.*

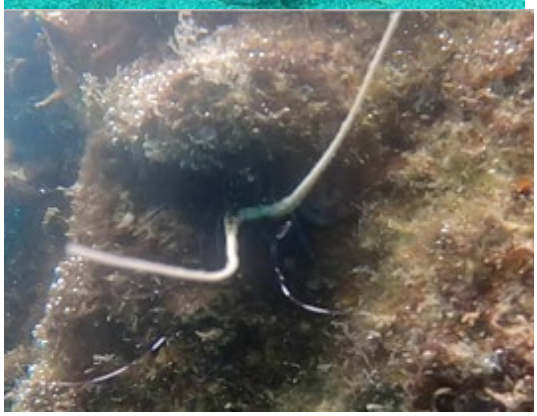
Plate 23: Hard coral colonies located either on or in close proximity to the Jaluit dock.




There was an absence of invertebrate sessile animals throughout the lagoon assessed sites with very limited numbers of mollusks (e.g. bivalves, gastropods, cephalopods), echinoderms (sea cucumbers) and crustaceans (e.g. crabs, crayfish) located. One cone shell (*Conus sp*.), two different spider conch shells species (*Lambis sp.)*, one juvenile tropical rock lobster (*Panulirus sp*.) and several individual feather duster worms (*Bispire sp.)* were recorded (Plate 24). There was no evidence of the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.* The absence of these resources is a direct result of the marine conditions prevailing at this site preventing recruitment and survival and anthropogenic usage (fishing pressure) of the resources.

Plate 24: Marine resources (a) cone shell (*Conus sp.)* (b) spider conch (*Lambis sp*.), (c) tropical lobster (*Panulirus sp.)* and (d) feather duster worm (*Bispire sp*.) located within the lagoon waters directly adjacent to the Jaluit dock.

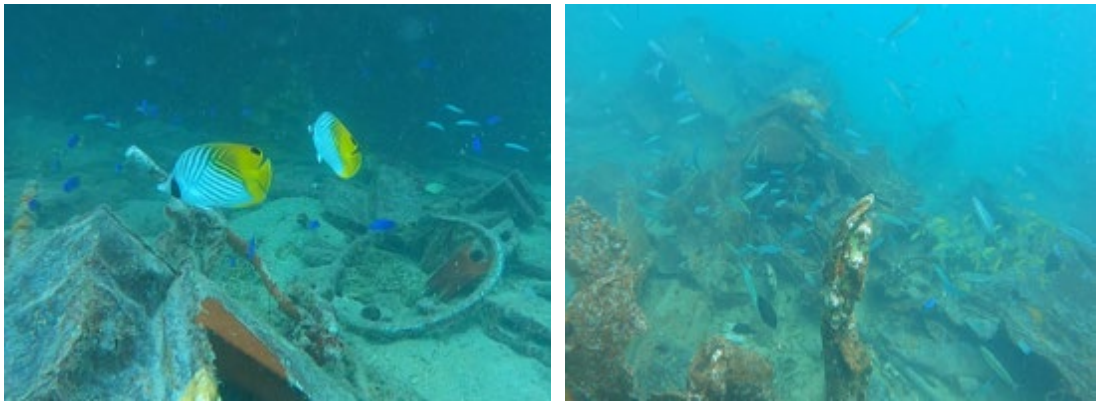





Finfish population numbers and species diversity remained low throughout the deeper water lagoon sites assessed, however significantly higher numbers and species were recorded than those located within the adjacent intertidal and subtidal reef flats. The absence of fish during the survey may be attributed to the time of the assessment and/or tidal height, however it may be a direct result of fishing pressure. Finfish species

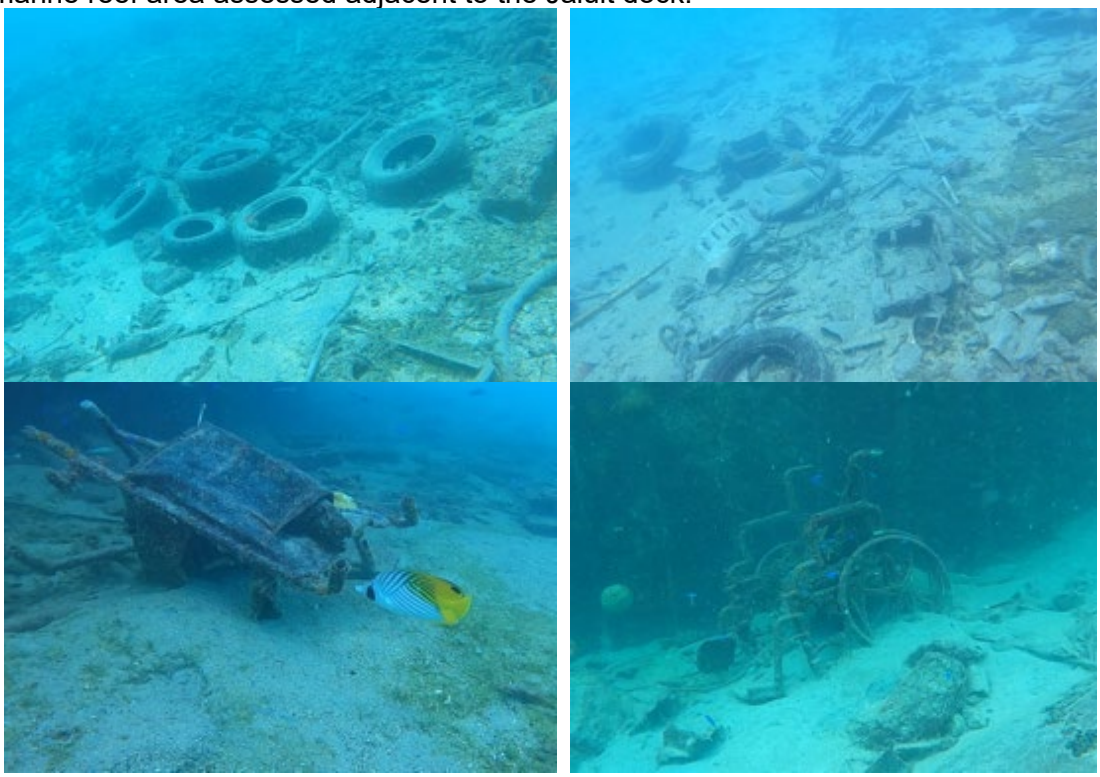
that were identified during the assessment were dominated by reef dwelling plankitvores (e.g. Pomacanthidae), corallivorous (butterfly fish – *Chaetodon sp.)* and herbivores (e.g. Acanthuridae, Scaridae) (Plate 25). Anecdotal information indicates that during high tide periods significant schools of "baitfish" (most likely scads) are located in and around the dock which are subsequently preyed on by a range of tropical predator fin fish (e.g. Trevallies, Barracuda etc) and as such the dock is used for fishing.

Plate 25: Marine finfish located within the reef areas directly adjacent to the Jaluit dock.



The marine benthic environment associated with the dock, especially the deeper waters in front of the dock (west) contained a significant amount of anthropogenic material, machinery and garbage (Plate 26). A benthic physical cleanup of this material is highly recommended.

Plate 26: Anthropogenic garbage located during the marine assessment within the marine reef area assessed adjacent to the Jaluit dock.



Key Findings of the Marine Assessment

The upgrading of the Jaluit dock does not impact any marine, coastal or terrestrial conservation and/or protected area, sites of cultural, customary or heritage significance nor any national or international marine, freshwater or terrestrial endangered or protected species. Thus no impacts on critical habitats are associated with this project.

The key findings of the shallow water marine benthic assessment of the Jaluit dock upgrade project include:

- The seabed substrate associated with the existing Jaluit dock is relatively homogenous and similar throughout the area. The substrate is characterized by a bottom layer of coarse sand, gravel and rocks derived from coral reef origins.
- The benthic substrate directly associated with the existing dock has been significantly altered and reclaimed for the construction of the dock. Adjacent coastal foreshore, beach, intertidal and upper subtidal reef flat have been significant altered resulting in degradation of the benthic ecosystem habitat and function throughout the site assessed.
- The reef system within the projects direct and indirect Area of Influence is relatively homogenous and includes a distinct zonation; a small foreshore beach which has underlying beach bedrock (calcium carbonate), small shallow water intertidal and subtidal reef flat that descend at a low gradient directly onto the seafloor within the lagoon (6-8m depth).
- Hard coral percent live coverage, morphological form, diversity and abundance was similar within the site assessed reflecting the natural and anthropogenic environmental forces affecting the different reef locations.
- Hard coral percentage live coverage associated with all reef zones was less than 1 %, with only isolated hard coral colonies attached to the dock sheet walls, concrete structures or elevated rocks on the sea floor substrate.
- Isolated branching colonies (*Acropora sp*.) were located within the subtidal reef flat to the south of the existing dock, these small isolated colonies were rare and possessed the highest coral coverage within the area assessed.
- No soft corals were recorded.
- Newly recruited hard coral colonies were located in very low numbers providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habit and resources.
- Coral species diversity and morphology remained similar in each of the reef zones throughout the assessment site.
- Hard coral small sub massive (e.g. *Porities sp., Monitipora sp.,*), digitate (*Porities sp*.), and branching (e.g. *Acropora sp., Pocillopora sp.*) morphological forms dominated the reef systems assessed.
- Marine macro algae density, coverage and species diversity was very low throughout the site. The red algae *Laurencia sp.* and the brown algae *Padina sp.* were the only macroalga recorded within this zone, the latter in very low population densities.
- No sea grass, mangroves nor rivers/streams were recorded within the assessed area.
- There were no threatened, endangered or endemic hard coral species, other invertebrate – vertebrate species located during the assessment for the reef systems adjacent to the dock.

- There were no marine mammals and/or marine reptiles (turtles) within or in close proximity to the dock.
- Finfish population numbers and species diversity was very low. Species that were present were juveniles and include reef dwelling plankitvores (small fish), herbivores (e.g. Acanthuridae, Scaridae), corallivores (e.g. Chaetodondae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates were recorded at all assessed sites. Those that were recorded have no subsistence or commercial value.
- No Crown of Thorns (COTS), coral eating gastropod snails (e.g. *Drupella sp.)* or coral disease were recorded during the assessment.
- The marine benthic environment associated with the dock contains significant anthropogenic community derived garbage, a physical cleanup is recommended.
- The benthic substrate associated with the Jaluit dock due to its environmental characteristics and past village coastal and intertidal reclamation activities, the benthic habitat within this area can be considered to have a low ecological habitat and value.

Key Environmental Impacts

The proposed scope of works to upgrade the existing Jaluit dock has a small environmental footprint both above and below the water level. Impacts on the marine environment and coastal waters within and around the dock are expected to be very minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures.

There are no threats to the area's marine and coastal biodiversity associated with the project. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, easily mitigatable and overall insignificant.

The potential impacts of the project on the marine biological environment include:

- There is potential for localized and temporary increased suspended sediment levels in the marine environment around the dock as a result of the projects scope of works. Such impacts are expected to be very minor due to i) the low habitat value of the benthic environment, ii) prevailing tidal current persisting at the site, and iii) the limited physical construction activities proposed.
- The tidal current associated with this site will disperse fine sediment quickly.
- Spillage/leakage of oil and other pollutants into the marine environment from plant and equipment used during the construction phase of the project.
- Benthic habitats associated with the footprint directly adjacent to the existing Jaluit dock supports a very low hard coral subtidal reef community that has been extensively degraded and altered due to past reclamation and construction activities. It is expected that a small number of hard coral colonies will be directly impacted by the projects activities, these losses will not be detrimental to the ecology of the site nor the species. The substrate between the hard coral is composed of sand containing a paucity of benthic sessile invertebrates.

As such the benthic habitat and ecosystem associated with the project sites may be classified as an extensively modified and disturbed benthic foreshore and marine

habitat of low ecological value. The proposed scope of works as such will have a negligible potential impact on these habitats, its resources and is acceptable.

Potential Impact Mitigation Measures

The potential impact of increased suspended sediment levels from the works can be further minimized through implementation of the following mitigation measures during the construction phase of the project:

- Ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the dock.

Due to the existing marine benthic environment and water circulation patterns associated with the Jaluit dock it is not recommended to use silt curtains during construction. The water current during tidal exchange will transport and allow suspended sediment to disperse throughout the adjacent waters, which are predominately sand lagoon sea floor significantly reducing potential sediment impacts on the live biota associated with the dock.

The contractor will be required to ensure all equipment is properly maintained and to follow all necessary precautions to prevent spillage of petrochemicals into the marine environment. Provided such measures are properly implemented the potential impacts on the marine environment will be insignificant.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works. There is no biological justification to relocate hard coral colonies that may be impacted by the projects scope of works.

3.3 Wotje Atoll Dock

Wotje Dock ($9^0$27’23.01”N and $170^0$14’01.52”E) is situated on the lagoon’s leeward side of the intertidal shoreline on the eastern side of Wotje atoll (refer Plate 3). The dock is directly attached and accessible to the shoreline through past reclamation activities and extends approximately 170 m into the lagoon. The docks facilities consist of a concrete, earth filled finger wharf with a small boat landing area on the southern side. Large vessels are unable to directly use the dock. The dock was extensively damaged by bombing in WWII with resulting debris scattered in the water around the outer end of the dock. A single lane coralline gravel road provides access from the dock to the nearby village. Past reclamation activities associated with the dock are restricted to the dock entry footprint with little alteration associated with the coastal foreshore beach and intertidal and subtidal reef flat to the north and south of the site.

A lagoon coastal coral reef and associated benthic resources are located adjacent to the shoreline of the Wotje dock. In general, the marine benthic habitat and resources throughout the area reflect a functioning natural marine ecosystem that has adapted to the past physical alterations associated with the dock. There is a paucity of benthic

fauna resource diversity and population densities next to and adjacent to the dock, whilst benthic flora (macroalgae) record high population densities and low diversity in areas where hard benthic substrate is present. The reef abiotic benthic systems associated with the dock site are very similar throughout the area assessed and are characterized by an extensive sand beach (calcium carbonate in origin), a small shallow intertidal reef flat with underlining beach rock, a larger subtidal reef flat that extends at a low vertical gradient into the atolls lagoon.

The Wotje dock impacts, and is directly located on the reef morphological areas including the coastal foreshore, beach rock, sand rubble beach, intertidal and subtidal reef flat, and lagoon itself.

There are no mangrove trees nor rivers/streams entering the coastline in close proximity to the dock site. During periods of high rainfall anecdotal information suggests that underground natural freshwater springs are located along the coastal beach adjacent to and in close proximity to the dock. Low levels of anthropogenic rubbish were located in the waters surrounding the dock.

An extensive foreshore beach is the dominate feature to the north and south of dock. The northern beach directly adjacent to dock is wider and more expansive than the beach to the south due to sand accumulation resulting from longshore drift accumulating sediment next to the dock.

The beach is composed of reef derived (calcium carbonate) sand and a considerable smaller rubble portion, ranges in width between 10-20 m, water depth fluctuates with the tide and weather conditions (e.g. wave action) and rest directly on top of a beach bedrock (Plate 27).

Plate 27: Beach adjacent north (a) and south (b) of the Wotje dock.

The seabed substrate adjacent to the dock is relatively homogenous throughout the assessment site and is characterized by a thick bottom layer of coarse calcium carbonate sand derived from coral reef and foraminifera origins. Finer sand deposition was recorded further into the lagoon, west of the dock.

Water turbidity and resulting water clarity surrounding the dock remains average, however fluctuations occur and are dependent on tidal height, water currents and weather conditions. These sediments do impact the water quality associated with the project site and have a direct impact on the benthic coral reef biotic resources.

Reef derived rocks, boulders and gravel were recorded throughout the area assessed. Higher percentage coverage of rock and gravel were recorded to the north and south directly adjacent to the dock extending from the intertidal zone adjacent to the sand beach through to the upper subtidal reef flat. These rock patches extended 40 m x 10 m, and 90 m x 13 m in the north and south respectively, covering areas of 400 m^2 in the north and 1,270 m^2 in the south.

The northern end of the dock has collapsed and recorded a significant number of concrete structures and bricks in the water located next to the existing dock. It is reported these are a result of bombing during WWII. There is no evidence of recent foreshore nor shallow water intertidal or subtidal sea floor dredging. Plate 28 provides representative photos of the benthic abiotic substrate located adjacent to the Wotje dock.

Plate 28: Representative photos of the benthic substrate associated with the Wotje dock.

The relatively high level of suspended sand based substrate (refer Plate 28) located at all assessment sites and the patchiness of hard benthic structures (e.g. rocks, reef) that are not covered in sand/silt has a significant detrimental effect on recruitment and survival of sessile benthic marine life. This has resulted in a paucity of sessile benthic invertebrate species throughout the area (significantly reduce hard coral percent coverage were recorded – refer below).

A healthy population of the marine sedentary peanut worm (polychaetes – *Sipuncula sp.)* burrows were recorded throughout the subtidal and lagoon sediments adjacent to the dock (Plate 29). These resources are mobile and can adapt to changes and/or disturbance in the benthic sediment profile.

Plate 29: Marine invertebrate polychaete burrows located within the subtidal and lagoon benthic environs during the marine assessment of the Wotje dock.

The intertidal reef flat adjacent to and running north and south of the Wotje dock, has a small linear width ranging between 20-30 m, averages less than 0.5 m in water depth (tidally influenced) and is exposed towards the beach during low water. The intertidal reef flat on both sides of the Wotje dock recorded no hard coral percent coverage and diversity. Hard coral absence throughout the assessed area is due to daily exposure in the intertidal zone and unsuitable water conditions for recruitment, growth and survival within the subtidal marine environment.

The subtidal reef flat is extensive on both sides of the dock and is an extension of the intertidal reef flat. The subtidal reef system has a linear width of approximately 120 m and 130 m north and south of the Wotje dock respectively, and has a water depth range of between 1.5 m and 3 m, the southern side is slightly deeper than the northern side of the dock. The subtidal reef flat has a gentle descending slope that transitions into the lagoon proper around the end of the Wotje dock. The gentle vertical sea floor slope continues into the lagoon proper.

Hard coral percentage coverage is very low in close proximity to the Wotje dock averaging less than 1%. The average hard coral percent coverage for the entire area assessed is less than 3 %, however ranged between no corals (0%) to 25% associated with isolated hard coral colonies. Higher percentage coverage was located within the subtidal and lagoon waters and at a minimum 20 m from the Wotje dock wall.

Isolated hard coral colonies, predominately *Pocillopora sp*. and *Porities sp.* were recorded attached to elevated hard substrates within the subtidal rock patches either side of the Wotje dock, isolated hard structures within the sand sea floor adjacent to the dock and/or to a much lower percentage attached to the dock wall (Plate 30). The northern side and western end of the dock showed slightly higher coral percentage coverage than the southern areas assessed.

Hard coral species diversity is low with morphological forms (size, structure) throughout the sites assessed relatively homogenous and reflects the ecosystem parameters within the area. Hard coral small sub massive (e.g. *Porities sp.*), digitate (*Porities sp*.) and branching (e.g. *Pocillopora sp.*) hard corals (refer Plate 30) were the dominate morphological forms located throughout the assessed area.

A number of colonies were located on or in close proximity to the dock recorded signs of stress (e.g. sedimentation) and there was a notable absence of large coral heads, table corals of any size and sea anemones at all sites assessed. There were no soft coral colonies and/or individuals located within these zones.

Evidence of hard coral recruitment was rare, with only a small number of coral colonies (*Pocillopora sp.)* located within the deeper water associated with both the sub tidal and lagoon sections directly adjacent to the dock. Thus providing direct evidence of natural hard coral recruitment is active in these areas, albeit in low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habitat and resources.

There was no evidence of hard coral disease (e.g. bacteria or virus), the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.*

Plate 30: Representative photos of hard coral colonies located during the marine benthic assessment directly adjacent to the Wotje dock.

The brown algae *Padina sp.* and *Dictyota sp*., and the red algae *Laurencia sp.* (Plate 31) were the dominate macroalga recorded throughout the sites assessed. Macroalgae percent coverage ranged between 10-80% with areas located on both sides of the Wotje dock within the subtidal zone associated with the rubble bed possessing the highest percentage coverage (60-80%). In addition, blue green algae were recorded in the subtidal and lagoon proper directly associated with the sea floor sand. Percentage coverage ranged between 05-20%.

Plate 31: Macroalgae located within the subtidal reef flat and lagoon adjacent to the Wotje dock.

Isolated small individuals colonies (patches) of sea grass (*Enhalus acoroides*) were recorded within the subtidal reef flat and lagoon proper on both sides of the Wotje dock (Plate 32). Colonies were small (less than 1 m^2) and density throughout the area was low and sporadic. Individual colonies were located in close proximity to the dock on the southern side within the subtidal reef flat. Anecdotal information identified sea grass colonies are located throughout the shallow water reef system associated with this area of Wotje atoll.

Plate 32: Seagrass located within the reef areas directly adjacent to the Wotje dock.

There was an paucity of invertebrate sessile animals throughout the assessed sites with very limited numbers of mollusks (e.g. bivalves, gastropods, cephalopods), echinoderms (sea cucumbers) and crustaceans (e.g. crabs, crayfish) located. The small black sea cucumber (*Holothuria atra*) was recorded in low densities on both sides of the Wotje dock within the intertidal and subtidal reef flats and several individual feather duster worms (*Bispire sp.)* were recorded throughout the area (Plate 33). There was no evidence of the Crown of thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.* The absence of these resources is a

direct result of the marine conditions prevailing at this site preventing recruitment and survival and anthropogenic usage (fishing pressure) of the resources.

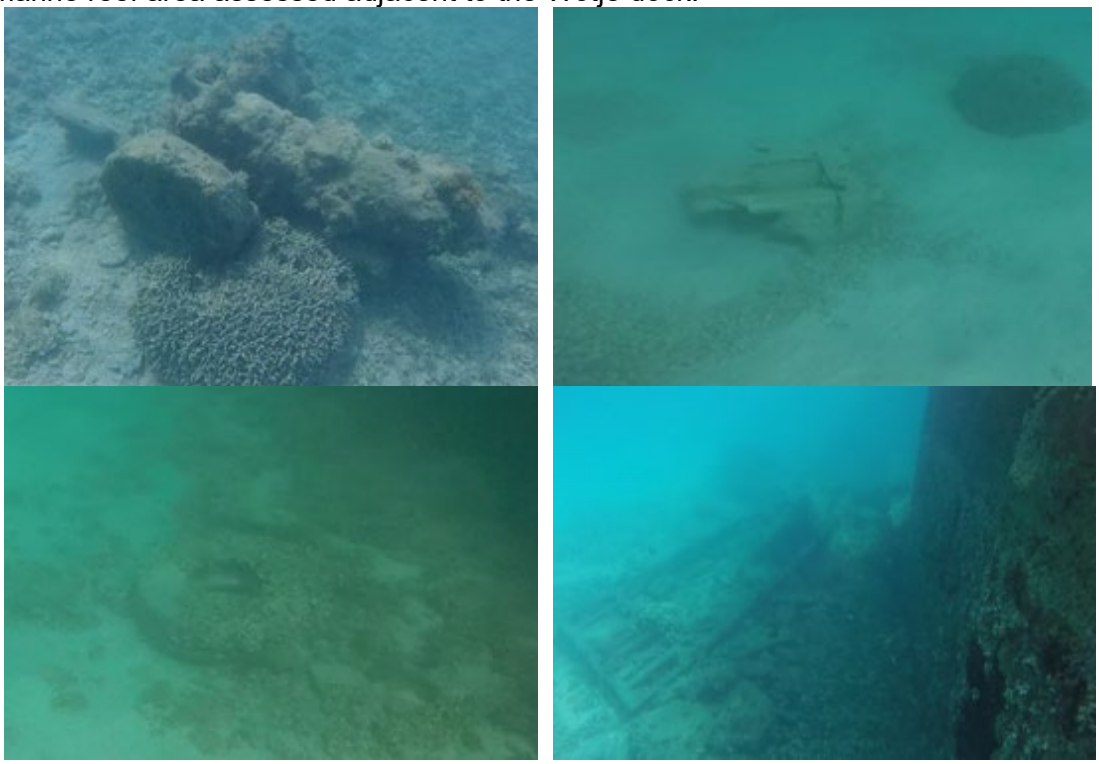
Plate 33: Marine resources (a) sea cucumber (*H. atra*) and (b) feather duster worm (*Bispire sp.*) located within the waters directly adjacent to the Wotje dock.


Finfish population numbers and species diversity was very low throughout the sites assessed (Plate 34). The paucity of fish during the survey may be attributed to the time of the assessment and/or tidal height, however it may also be a direct result of fishing pressure. Finfish species that were identified during the assessment were dominated by reef dwelling plankitvores (e.g. Pomacanthidae), corallivorous (butterfly fish – *Chaetodon sp.)* and herbivores (e.g. Acanthuridae, Scaridae).

Plate 34: Marine finfish located within the reef areas directly adjacent to the Wotje dock.


The marine benthic environment associated with the dock contained a small amount of anthropogenic used material and machinery (Plate 35) of which much was located toward the western end of the dock. A benthic physical cleanup of this material is recommended.

Plate 35: Anthropogenic material located during the marine assessment within the marine reef area assessed adjacent to the Wotje dock.



Key Findings of the Marine Assessment

The upgrading of the Wotje dock does not impact any marine, coastal or terrestrial conservation and/or protected area, sites of cultural, customary or heritage significance nor any national or international marine, freshwater or terrestrial endangered or protected species. Thus no impacts on critical habitats are associated with this project.

The key findings of the shallow water marine benthic assessment of the Wotje dock upgrade project include:

- The seabed substrate associated with the existing Wotje dock is relatively homogenous and similar throughout the area. The substrate is characterized by a bottom layer of coarse sand, gravel and rocks derived from coral reef origins.
- The benthic substrate directly associated with the existing dock has been significantly altered and reclaimed for the construction of the dock. Adjacent coastal foreshore, beach, intertidal and upper subtidal reef flat and lagoon have not been altered and as such remain functioning as a natural benthic ecosystem.
- The reef system within the projects direct and indirect Area of Influence is relatively homogenous and includes a distinct zonation; an extensive foreshore beach which has underlying beach bedrock (calcium carbonate), shallow water intertidal and subtidal reef flat that descend at a low gradient directly onto the seafloor within the lagoon.
- Hard coral percent live coverage, morphological form, diversity and abundance was similar within the site assessed reflecting the natural and anthropogenic environmental forces affecting the different reef locations.

- Hard coral percentage live coverage associated with all reef zones was less than 3%, however percent coverage ranged between no corals (0%) to 25% associated with isolated hard coral colonies.
- Isolated hard coral colonies were recorded attached to elevated hard substrates within the subtidal rock patches either side of the Wotje dock, isolated hard structures within the sand sea floor adjacent to the dock and/or to a much lower percentage attached to the dock wall.
- No soft corals were recorded.
- Newly recruited hard coral colonies were located in very low numbers providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habit and resources.
- Coral species diversity and morphology remained similar in each of the reef zones throughout the assessment site.
- Hard coral small sub massive (e.g. *Porities sp.*), digitate (*Porities sp.*) and branching (e.g. *Pocillopora sp.*) morphological forms dominated the reef systems assessed.
- Macroalgae (*Padina sp.*, *Dictyota sp.*, and *Laurencia sp.*,) percent coverage ranged between 10-80% with areas located on both sides of the Wotje dock within the subtidal zone associated with the rubble bed possessing the highest percentage coverage (60-80%). In addition, blue green algae percent coverage range between 10-30% associated with the subtidal and lagoon sand seafloor.
- Isolated small individuals colonies (patches) of sea grass (*Enhalus acoroides*) were recorded within the subtidal and lagoon proper on both sides of the Wotje dock. Colonies were small (less than 1 m^2) and density throughout the area was very low and sporadic.
- No mangroves nor rivers/streams were recorded within the assessed area.
- There were no threatened, endangered or endemic hard coral species, other invertebrate – vertebrate species located during the assessment for the reef systems adjacent to the dock.
- There were no marine mammals and/or marine reptiles (turtles) within or in close proximity to the dock.
- Finfish population numbers and species diversity was very low. Species that were present were juveniles and include reef dwelling plankitvores (small fish) and herbivores (e.g. Acanthuridae, Scaridae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates were recorded at all assessed sites. Those that were recorded have no subsistence or commercial value.
- No Crown of Thorns (COTS), coral eating gastropod snails (e.g. *Drupella sp.)* or coral disease were recorded during the assessment.
- The marine benthic environment associated with the dock contains anthropogenic community derived garbage, a physical cleanup is recommended.
- The benthic substrate associated with the Wotje dock due to its environmental characteristics and past village coastal and intertidal reclamation activities, the benthic habitat within this area can be considered to have a low ecological habitat and value.

Key Environmental Impacts

The proposed scope of works to upgrade the existing Wotje dock has a small environmental footprint both above and below water level. Impacts on the marine environment and coastal waters within and around the dock are expected to be very minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures.

There are no threats to the area's marine and coastal biodiversity associated with the project. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, easily mitigatable and overall insignificant.

The potential impacts of the project on the marine biological environment include:

- There is potential for localized and temporary increased suspended sediment levels in the marine environment around the dock as a result of the projects scope of works. Such impacts are expected to be very minor due to i) the low habitat value of the benthic environment, ii) prevailing tidal current persisting at the site, and iii) the limited physical construction activities proposed.
- The tidal current throughout the area will disperse fine sediment quickly.
- Spillage/leakage of oil and other pollutants into the marine environment from plant and equipment used during the construction phase of the project.
- Benthic habitats associated with the footprint directly adjacent to the existing Wotje dock supports a low hard coral and seagrass subtidal reef community that has been extensively degraded and altered due to past reclamation and construction activities of the dock. It is expected that a very small number of hard coral colonies and seagrass will be directly impacted by the projects activities, these losses will not be detrimental to the ecology of the site nor the species. The substrate between the hard coral and seagrass is composed of sand containing a paucity of benthic sessile invertebrates.

As such the benthic habitat and ecosystem associated with the project sites may be classified as a modified and disturbed benthic foreshore and marine habitat of low ecological value. The proposed scope of works as such will have a negligible potential impact on these habitats, its resources and is acceptable.

Potential Impact Mitigation Measures

The potential impact of increased suspended sediment levels from the works can be further minimized through implementation of the following mitigation measures during the construction phase of the project:

- Ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the dock.

Due to the existing marine benthic environment and water circulation patterns associated with the Wotje dock it is not recommended to use silt curtains during constructions. The water current during tidal exchange will transport and allow suspended sediment to disperse throughout the adjacent waters, which are predominately sand lagoon sea floor significantly reducing potential sediment impacts on the live biota, especially hard corals.

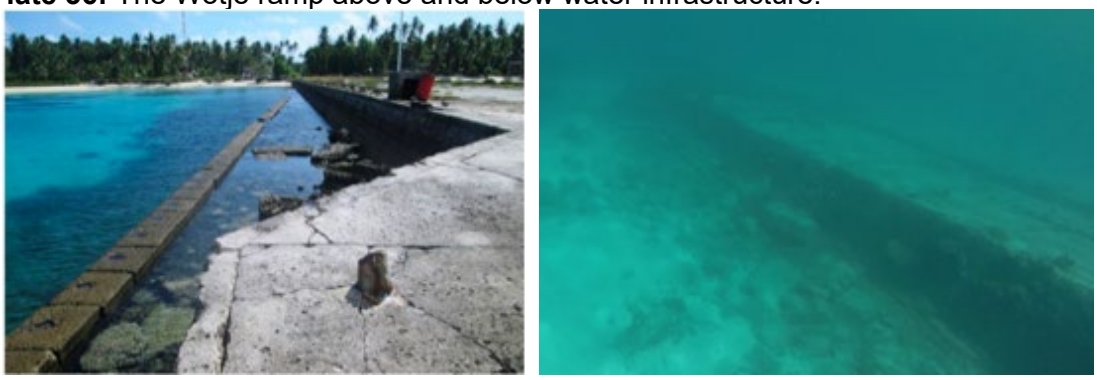
The contractor will be required to ensure all equipment is properly maintained and to follow all necessary precautions to prevent spillage of petrochemicals into the marine environment. Provided such measures are properly implemented the potential impacts on the marine environment will be insignificant.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works. There is no biological justification to relocate hard coral colonies that may be impacted by the projects scope of works.

3.4 Wotje Atoll Ramp

Wotje Ramp ($9^0$27'36.76"N and $170^0$13'53.87"E) is situated on the lagoon's leeward side of the intertidal shoreline in the eastern side of Wotje atoll (refer Plate 3). The ramp is directly attached and accessible to the shoreline through past reclamation activities and extends approximately 200 m into the lagoon, including approximately 170 m above water and approximately 30 m below water (Plate 36). The ramp facilities consist of a concrete finger structure that is in poor structural shape and is used to transfer petrochemical products onto the Island. The northern side of ramp includes a cement revetment wall approximately 5 m adjacent to and running parallel to the ramp wall proper (refer Plate 36), which is underwater during high tides. The past reclamation activities associated with the dock are restricted to the ramp entry footprint with little alteration associated with the coastal foreshore beach and intertidal and subtidal reef flat to the north and south of the site. A single lane coralline gravel road provides access from the ramp to the nearby village.

Plate 36: The Wotje ramp above and below water infrastructure.



A lagoon coastal coral reef and associated benthic resources are located adjacent to the shoreline associated with the Wotje ramp. In general, the marine benthic habitat and resources throughout the area reflect a functioning natural marine ecosystem that has adapted to the past physical alterations associated with the ramp. There is a healthy population density of both benthic sessile marine fauna (e.g. hard coral) and flora (marcoalgae) resource next to and adjacent to the ramp, in all areas that possess a hard substrate. Biodiversity for both flora and fauna is low.

The reef abiotic benthic systems associated with the ramp site are very similar throughout the area assessed and are characterized by an extensive sand beach

(calcium carbonate in origin), a shallow intertidal reef flat with underlining beach rock, a larger subtidal reef flat that extends at a low vertical gradient into the atolls lagoon. The Wotje ramp impacts, and is directly located on the reef morphological areas including the coastal foreshore, beach rock, sand rubble beach, intertidal and subtidal reef flat, and lagoon itself.

There are no mangrove trees nor rivers/streams entering the coastline in close proximity to the ramp site. During periods of high rainfall anecdotal information suggests that underground natural freshwater springs are located along the coastal beach adjacent to and in close proximity to the dock. Low levels of anthropogenic rubbish were located in the waters surrounding the ramp.

An extensive foreshore beach is the dominate feature to the north and south of ramp. The northern beach directly adjacent to ramp is wider and more expansive than the beach to the south due to sand accumulation resulting from longshore drift accumulating sediment next to the ramp.

The beach is composed of reef derived (calcium carbonate) sand and a considerable smaller rubble portion, ranges in width between 20-25m, water depth fluctuates with the tide and weather conditions (e.g. wave action) and rest directly on top of a beach bedrock (Plate 37)

Plate 37: Beach adjacent north (a) and south (b) of the Wotje ramp.

The seabed substrate adjacent to the ramp is relatively homogenous throughout the assessment site and is characterized by a thick bottom layer of coarse calcium carbonate sand derived from coral reef and foraminifera origins. Finer sand deposition was recorded further into the lagoon.

Water turbidity and resulting water clarity surrounding the ramp remains average, however fluctuations occur and are dependent on tidal height, water currents and weather conditions. These sediments do impact the water quality associated with the project site and have a direct impact on the benthic coral reef biotic resources.

Reef derived rocks, boulders and gravel were recorded throughout the area assessed. Directly adjacent to and on both the northern and southern sides of the ramp are extensive gravel and rock substrate beds that extent the entire length of the ramp, originating directly adjacent to the sand beach west through to the lagoon. Higher percentage coverage of rock and gravel were recorded on the northern side of the ramp. These rock patches extended 150 m in length and is 24 m wide, and 150 m length and is 13 m wide in the north and south respectively, covering areas of 3,600 m^2 in the north and 1,950 m^2 in the south.

The northern interface of the ramp between above and below water has been damaged resulting in a number of the original concrete plates and boundary supports dislodged and scattered both on the ramp itself and in adjacent water. There is no evidence of recent foreshore nor shallow water intertidal or subtidal sea floor dredging. Plate 38 provides representative photos of the benthic abiotic substrate located adjacent to the Wotje ramp.

Plate 38: Representative photos of the benthic substrate associated with the Wotje ramp.

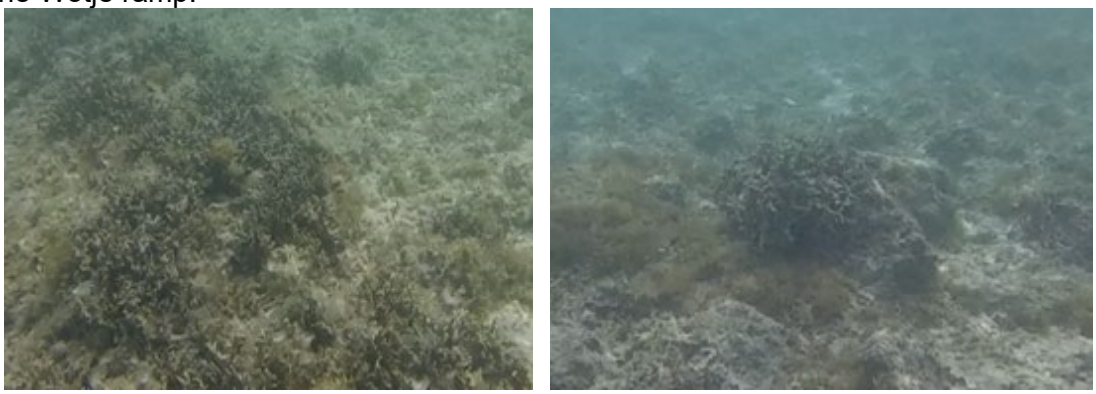
Although there are relatively high level of suspended silt and sand based substrate (refer Plate 38) located at all assessment sites, the availability of a hard benthic structures (rocks, reef etc) that are not covered in sand/silt provides a suitable substrate for the recruitment and survival of sessile (e.g. hard coral and macroalgae) benthic marine life. Resulting in significant percentage coverage of sessile benthic flora and fauna associated with a hard seafloor. In addition, a healthy population of marine sedentary peanut worm (polychaetes – *Sipuncula sp.)* burrows were recorded throughout the subtidal and lagoon sediments adjacent to the ramp in areas where sand deposition is present (Plate 39). These resources are mobile and can adapt to changes and/or disturbance in the benthic sediment profile.

Plate 39: Marine invertebrates polychaete burrows located within the subtidal and lagoon benthic environs during the marine assessment of the Wotje dock.

The intertidal reef flat adjacent to and running north and south of the Wotje ramp, has a linear width of approximately 60 m, averages less than 1.0 m in water depth (tidally influenced) and is exposed towards the beach during low water. The intertidal reef flat on the southern side of the Wotje ramp recorded no hard coral colonies, whilst a very low level hard coral percent coverage and diversity was recorded for the northern side, all towards the western end of the intertidal reef flat. This included only several isolated

digitate (*Porities sp.)* and small branching (*Acropora sp.)* colonies (Plate 40). In general, the paucity of hard corals throughout the majority of the intertidal assessed area is due to daily exposure in the intertidal zone and unsuitable water conditions for recruitment, growth and survival within the subtidal marine environment.

Plate 40: Hard coral colonies located within the northern intertidal reef flat adjacent to the Wotje ramp.



The subtidal reef flat is extensive on both sides of the dock and is an extension of the intertidal reef flat. The subtidal reef system has a linear width of approximately 150 m for both the northern and southern side of the Wotje ramp and has a water depth range of between 1.5 m and 3 m, with the northern side slightly deeper than the southern side of the ramp. The subtidal reef flat has a gentle descending slope that transitions into the lagoon proper around the end of the Wotje ramp. The gentle vertical sea floor slope continues into the lagoon proper.

Hard coral percentage coverage is variable in close proximity to the Wotje ramp averaging between <5% - 50% for the northern reefs and <5 - 35% for the southern reef systems adjacent to the ramp. The location of hard coral colonies are directly related to the presence of an elevated and benthic substrate.

Hard coral colonies, predominately *Porities sp.* and *Acropora sp*. were recorded attached to elevated hard substrates within the subtidal rock patches either side of the Wotje ramp, isolated hard structures within the sand sea floor adjacent to the ramp and/or to a much lower percentage attached to the ramp concrete wall (Plate 41).

Hard coral species diversity is low with morphological forms (size, structure) throughout the sites assessed relatively homogenous and reflects the ecosystem parameters within the area. Hard coral digitate (*Porities sp*.,) and branching (e.g. *Acropora sp*. and *Pocillopora sp.* to a much lesser degree) hard corals (refer Plate 41) were the dominate morphological forms located throughout the assessed area. Isolated small sub massive hard corals (e.g. *Porities sp*.,) were located throughout the areas assessed in very low numbers.

A number of colonies located on or in close proximity to the ramp on both sides recorded signs of stress (e.g. sedimentation) with patches of the sea floor devoid of hard corals with what appears to be evidence of surface scouring. In these locations marcoalgae population densities were high (refer section below). There was a notable absence of large coral heads, table corals of any size and sea anemones at all sites assessed. There were no soft coral colonies and/or individuals located within these zones.

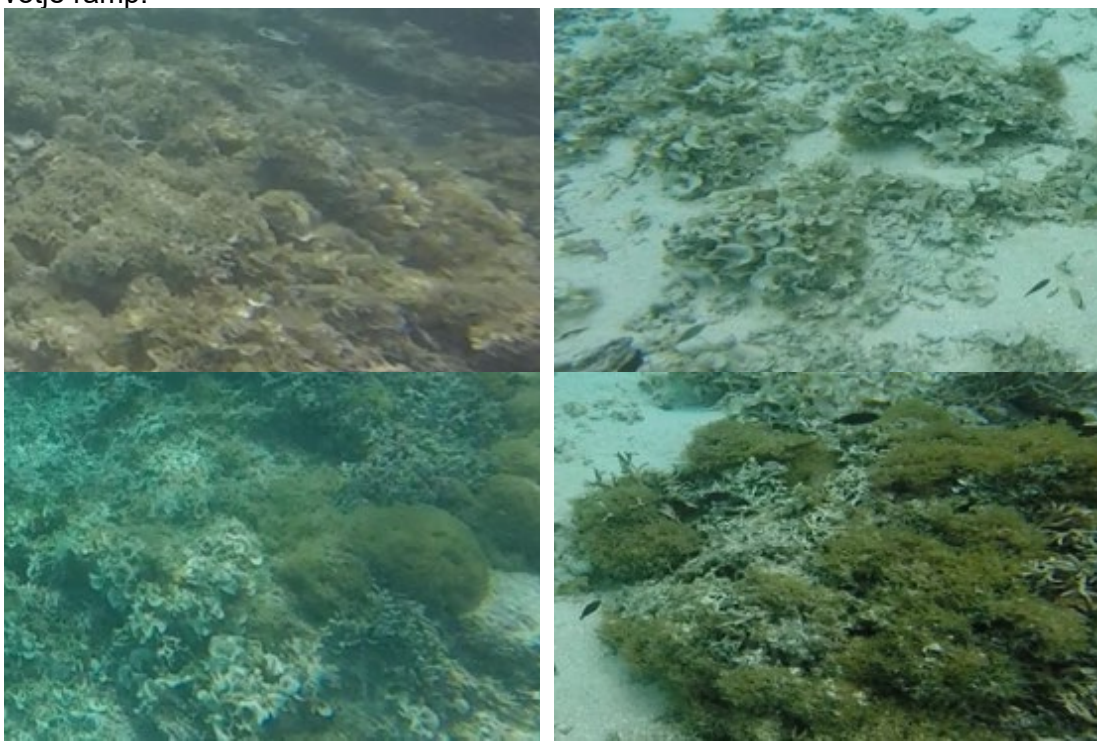
Evidence of hard coral recruitment was recorded throughout the area assessed for the dominant hard coral species. Thus providing direct evidence of natural hard coral recruitment is active in these areas.

There was no evidence of hard coral disease (e.g. bacteria or virus), the Crown of Thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.*

Plate 41: Representative photos of hard coral colonies located during the marine benthic assessment directly adjacent to the Wotje ramp.

The brown algae *Padina sp,.* and *Dictyota sp*., (Plate 42) were the dominate macroalga recorded throughout the sites assessed. Macroalgae percent coverage ranged between 10-80% with areas located on both sides of the Wotje ramp within the subtidal zone associated with the rubble bed possessing the highest percentage coverage (60-80%).

Plate 42: Macroalgae located within the subtidal reef flat and lagoon adjacent to the Wotje ramp.

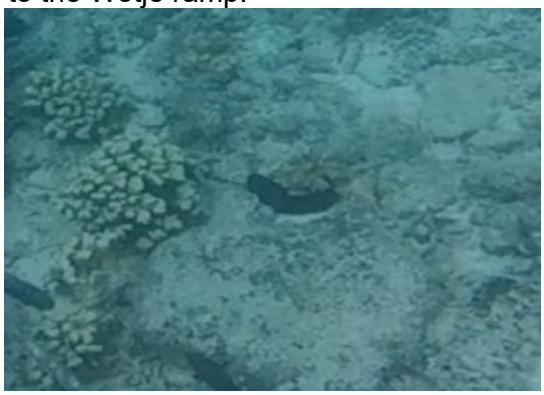


One isolated individual colony (patch) of sea grass (*Enhalus acoroides*) was recorded within the subtidal reef flat on the northern side of the Wotje ramp (Plate 43). No other sea grass colonies were recorded. The colony was small (less than 1 m^2). Anecdotal information identified sea grass colonies are located throughout the shallow water reef system associated with this area of Wotje atoll.

Plate 43: Seagrass colony located within the subtidal reef area directly adjacent to the Wotje ramp.

There was an paucity of invertebrate sessile animals throughout the assessed sites with very limited numbers of mollusks (e.g. bivalves, gastropods, cephalopods), echinoderms (sea cucumbers) and crustaceans (e.g. crabs, crayfish) located. Two species of sea cucumber were recorded (*Holothuria atra* and *Stichopus chloronotus*) in very low densities on both sides of the Wotje ramp within the subtidal reef flats (Plate 44). There was no evidence of the Crown of thorns starfish (*Acanthaster planci*) nor the coral eating predator gastropod snail *Drupella sp.* The absence of these resources is a direct result of the marine conditions prevailing at this site preventing recruitment and survival and anthropogenic usage (fishing pressure) of the resources.

Plate 44: The two species of sea cucumber (a) *H. atra* and (b) *S. chloronotus* located within the intertidal waters directly adjacent to the Wotje ramp.



Finfish population numbers and species diversity was very low throughout the sites assessed. The paucity of fish during the survey may be attributed to the time of the assessment and/or tidal height, however it may also be a direct result of fishing pressure. Finfish species that were identified during the assessment were dominated by reef dwelling plankitvores (e.g. Pomacanthidae), corallivorous (butterfly fish – *Chaetodon sp.)* and herbivores (e.g. Acanthuridae, Scaridae) (Plate 45).

Plate 45: Marine finfish located within the reef areas directly adjacent to the Wotje ramp.


The marine benthic environment associated with the ramp contained a small amount of anthropogenic used material and machinery (Plate 46) of which much was located adjacent to the western end of the ramp. A benthic physical cleanup of this material is recommended.

Plate 46: Anthropogenic material located during the marine assessment within the marine reef area assessed adjacent to the Wotje ramp.


Key Findings of the Marine Assessment

The upgrading of the Wotje ramp does not impact on any marine, coastal or terrestrial conservation and/or protected area, sites of cultural, customary or heritage significance nor any national or international marine, freshwater or terrestrial endangered or protected species. Thus no impacts on critical habitats are associated with this project.

The key findings of the shallow water marine benthic assessment of the Wotje ramp upgrade project include:

- The seabed substrate associated with the existing Wotje ramp is relatively homogenous and similar throughout the area. The substrate is characterized by a bottom layer of coarse sand, gravel, rocks and small boulders derived from coral reef origins.
- The benthic substrate directly associated with the existing ramp has been significantly altered and reclaimed for the construction of the ramp. Adjacent coastal foreshore, beach and intertidal and subtidal reef flat and lagoon have not been altered and as such remain functioning as a natural benthic ecosystem.

- The reef system within the projects direct and indirect Area of Influence is relatively homogenous and includes a distinct zonation; an extensive foreshore beach which has underlying beach bedrock (calcium carbonate), shallow water intertidal and subtidal reef flat that descend at a low gradient directly onto the seafloor within the lagoon.
- Hard coral percent live coverage, morphological form, diversity and abundance was similar within the site assessed reflecting the natural and anthropogenic environmental forces affecting the different reef locations.
- Hard coral percentage live coverage associated with all reef zones was variable, averaging between <5% to 50% coverage for the northern reefs and <5 to 35% for the southern reefs.
- Hard coral colonies were recorded attached to elevated hard substrates within the subtidal rock patches either side of the Wotje ramp, isolated hard structures within the sand sea floor adjacent to the dock and/or to a much lower percentage attached to the dock wall.
- No soft corals were recorded.
- Newly recruited hard coral colonies were located in very low numbers providing direct evidence of natural hard coral recruitment is active in these areas, albeit in very low numbers. This is a direct reflection of past anthropogenic impacts to the marine benthic habit and resources.
- Coral species diversity and morphology remained similar in each of the reef zones throughout the assessment site.
- Hard coral small sub massive (e.g. *Porities sp*.), digitate (*Porities sp*.) and branching (e.g. *Porities sp.*) morphological forms dominated the reef systems assessed.
- Macroalgae (*Padina sp*., *Dictyota sp*.,) percent coverage ranged between 10-80% with areas located on both sides of the Wotje ramp within the subtidal zone associated with the rubble bed possessing the highest percentage coverage (60-80%).
- One individual sea grass (*Enhalus acoroides*) colony (patch) was recorded within the subtidal reef on the northern side of the Wotje ramp. The colony was small (less than 1 m^2).
- No mangroves nor rivers/streams were recorded within the assessed area.
- There were no threatened, endangered or endemic hard coral species, other invertebrate – vertebrate species located during the assessment for the reef systems adjacent to the dock.
- There were no marine mammals and/or marine reptiles (turtles) within or in close proximity to the dock.
- Finfish population numbers and species diversity was very low. Species that were present were juveniles and include reef dwelling plankitvores (small fish) and herbivores (e.g. Acanthuridae, Scaridae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates were recorded at all assessed sites. Those that were recorded have no subsistence or commercial value.
- No Crown of Thorns (COTS), coral eating gastropod snails (e.g. *Drupella sp.)* or coral disease were recorded during the assessment.
- The marine benthic environment associated with the ramp contains anthropogenic community derived garbage, a physical cleanup is recommended.
- The benthic substrate associated with the Wotje ramp due to its environmental characteristics and past village coastal and intertidal reclamation activities, the

benthic habitat within this area can be considered to have a low ecological habitat and value.

Key Environmental Impacts

The proposed scope of works to upgrade the existing Wotje ramp has a small environmental footprint both above and below water level. Impacts on the marine environment and coastal waters within and around the ramp are expected to be very minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures.

There are no threats to the area's marine and coastal biodiversity associated with the project. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, easily mitigatable and overall insignificant.

The potential impacts of the project on the marine biological environment include:

- There is potential for localized and temporary increased suspended sediment levels in the marine environment around the ramp as a result of the projects scope of works. Such impacts are expected to be very minor due to i) the relatively low habitat value of the benthic environment, ii) prevailing tidal current persisting at the site, and iii) the limited physical construction activities proposed.
- The tidal currents throughout the area will disperse fine sediment quickly.
- Spillage/leakage of oil and other pollutants into the marine environment from plant and equipment used during the construction phase of the project.
- Benthic habitats associated with the footprint directly adjacent to the existing Wotje ramp supports a hard coral subtidal and lagoon reef community that has been degraded and altered due to past reclamation and construction activities of the ramp. It is expected that a small number of hard coral colonies will be directly impacted by the projects activities, these losses will not be detrimental to the ecology of the site nor the species. The substrate between the hard coral is composed of sand containing a paucity of benthic sessile invertebrates.

As such the benthic habitat and ecosystem associated with the project sites may be classified as a modified and disturbed benthic foreshore and marine habitat of low ecological value. The proposed scope of works as such will have a negligible potential impact on these habitats, its resources and is acceptable.

Potential Impact Mitigation Measures

The potential impact of increased suspended sediment levels from the works can be further minimized through implementation of the following mitigation measures during the construction phase of the project:

- Ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the ramp.

Due to the existing marine benthic environment and water circulation patterns associated with the Wotje ramp it is not recommended to use silt curtains during constructions. The water current during tidal exchange will transport and allow suspended sediment to disperse throughout the adjacent waters, which are

predominately sand lagoon sea floor significantly reducing potential sediment impacts on the live biota, especially hard corals.

The contractor will be required to ensure all equipment is properly maintained and to follow all necessary precautions to prevent spillage of petrochemicals into the marine environment. Provided such measures are properly implemented the potential impacts on the marine environment will be insignificant.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works. There is no biological justification to relocate hard coral colonies that may be impacted by the projects scope of works.

4 POTENTIAL IMPACTS TO THE MARINE ENVIRONMENT ASSOCIATED WITH THE DOCKS RAMP UPGRADE PROJECTS

4.1 Key Summary Findings of the Marine Assessment

Detailed benthic habitat and resource assessment findings for each of the project docks and ramp are presented in the individual chapters of this report and should be referred for additional baseline information.

The marine assessments sites assessed for Arno, Jaluit and Wotje atoll docks and Wotje atoll ramp do not impact any marine (intertidal and subtidal) or coastal conservation and/or protected area/s, sites of cultural, customary or heritage significance nor any national or international marine or coastal (terrestrial) endangered or protected species. Thus there are no impacts on critical habitats associated with the dock/ramp projects.

Key summary findings of the marine benthic assessment of the three docks and one ramp are summarized below and includes:

- Coral reefs were associated with all three (3) docks and one (1) ramp sites.
- The coral reef ecosystem impacted by the projects at all sites recorded a similar benthic zonation including; a coastal sand beach (reclaimed and impacted at all sites) with a hard bedrock base layer dominated by varying proportions of coral sand, coral rubble and rocks; an intertidal reef flat which varied in linear width, ranged in water depth between 0–1 m and is exposed in part during low spring tides (e.g. Arno Atoll site); a subtidal reef flat which varied in linear width, ranged in water depth between 1-3m and a gentle vertical sloping sand lagoon (Jaluit and Wotje sites).
- The reef zones impacted by the project include; foreshore beach and intertidal lagoon areas only for Arno Atoll dock, whilst the foreshore beach, intertidal, subtidal and lagoon areas for Jaluit and Wotje sites.
- Significant foreshore and marine impacts are associated with all sites, including extensive past dredging activities associated with the Arno dock resulting in

significant abiotic changes to the benthic environment and subsequent impact to benthic resources.

- Increased sedimentation has resulted from past benthic alterations (impacts) at all sites.
- No estuaries or rivers/streams were associated with any of the project sites.
- Hard coral percent live coverage, morphological form, diversity and abundance varied between all sites and reef zonation.
- No soft corals nor mangroves were recorded associated with any of the sites.
- The subtidal reef flat at all sites recorded the highest hard coral percent coverage, population densities and diversity.
- Hard coral morphology varied between the sites reflecting the natural environmental forces affecting the different reef locations.
- Hard coral species diversity, abundance and morphological form was low at all sites due in part to the natural ecosystems at these sites, however past reclamation and alteration activities has significantly altered and reduced these parameters.
- Hard coral digitate (e.g. *Porites sp.),* branching (e.g. *Acropora sp*., *Pocillopora sp.),* sub massive (e.g. *Porities sp*.,) morphological forms dominated the reef systems associated with all sites.
- There was an absence of large massive coral heads, plates and table corals at all sites.
- Hard coral recruited was recorded at all sites, however numbers of new recruits and small juvenile corals at all sites was very low thus providing direct evidence of natural hard coral recruitment is active in these areas, albeit in low numbers.
- No were no Crown of thorn starfish, hard coral predator gastropods (*Drupella sp*.) nor hard coral viruses were located during the assessment at any site.
- Isolated small colonies (patches 1m^2) of sea grass (*Enhalus acoroides)* were recorded at the Wotje dock and ramp only. Their presence was recorded in close proximity to the dock and ramp and through anecdotal information are recorded throughout this section of the Wotje atoll. Impacts perceived from the projects development on these resources are expected to be very minor.
- Marine macro algae density, coverage and diversity varied at each site with significant percent coverage recorded for areas associated with the dock and ramp for all sites. Wotje and Arno atolls sites recorded percent coverage in excess of 80%.
- The dominate marcoalgae recorded at all sites included the brown algae (*Padina sp.* and *Dictyota sp,), the red algae (Laurencia sp.) with isolated populations of the green algae Halimeda sp*. The red crustose coralline algae was only located at the Arno dock site.
- Finfish population numbers and species diversity was low at all sites assessed. Species that were present were juveniles and include reef dwelling plankitvores (small fish), herbivores (e.g. Acanthuridae, Scaridae) and there was a noticeable lack of predator reef fish.
- Very low numbers of reef associated invertebrates (apart from corals) were recorded at all assessed sites. Those that were recorded have no subsistence or commercial value, indicating high level of specific resource exploitation.
- Garbage (e.g. machinery, equipment) was located on the seafloor at all sites with Jaluit dock possessing significant levels of material in close proximity to the dock. Physical clean up at all sites should be considered.
- Past reclamation activities including the construction of the docks and ramp at all sites has significantly degraded water quality (e.g. high siltation levels, reduction of benthic habitat) and hard coral communities in close proximity to

this site are negatively impacted including hard coral colony mortality. Arno dock site possessed the highest levels of suspended sediment and poor water clarity in and around the dock, especially the southern site (dredged site). The siltation associated with the Arno dock site has been discharge onto the outer reef systems adjacent to the dock causing significant hard coral mortality.

- The elevated level of suspended sediment coupled with the significant benthic sediment layer (silt) on the seafloor at all sites has had a detrimental effect on the ability of sessile benthic marine resources to settle (recruit) and survive.
- There were no threatened, endangered or endemic hard coral species located during the assessment for the reef systems within the direct and indirect Area of Influence for all docks and ramp.
- There are no marine or coastal designated marine protected areas or areas of significant biodiversity within or in close proximity to the dock/ramp sites.
- There are no sites of cultural, customary or heritage significance nor any national or international endangered or protected species within or in close proximity to the dock and ramp sites.
- The benthic substrate and resources at all docks and ramp sites are highly modified by past anthropogenic impacts (dock/ramp construction, dredging and shoreline reclamation activities) and as such the benthic habitat at all sites can be considered to have low habitat and ecological value.

4.2 Key Environmental Impacts

The proposed scope of works associated with the Arno, Jaluit and Wotje atoll docks and Wotje atoll ramp all have a small environmental footprint both above and below water level. Impacts on the marine environment and coastal waters within and around the sites are expected to be minor, localized to the immediate footprint of the works, and easily managed through standard engineering good practice mitigation measures.

Therefore, there are no threats to the area's marine and coastal biodiversity associated with the projects. As such the potential impacts of the works on the marine environment are considered to be minor, temporary, easily mitigatable and overall insignificant.

The potential impacts of the project on the marine biological environment include:

- There is potential for localized and temporary increased suspended sediment levels in the marine environment around the docks/ramp as a result of the projects scope of works. Such impacts are expected to be very minor due to i) the relatively low habitat value of the benthic environments, ii) prevailing tidal current persisting at the site, and iii) the limited physical construction activities proposed.
- The tidal currents throughout the area at all sites will disperse fine sediment quickly.
- Spillage/leakage of oil and other pollutants into the marine environment from plant and equipment used during the construction phase of the project.
- Benthic habitats associated with the footprint directly adjacent to the existing docks and Wotje ramp do support a hard coral reef community that has been degraded and altered due to past reclamation and construction activities. It is expected that a very small number of hard coral colonies will be directly impacted by the projects activities, these losses will not be detrimental to the ecology of the site nor the species. The substrate between the hard coral is composed of sand containing a paucity of benthic sessile invertebrates.

As such the benthic habitat and ecosystem associated with the project sites may be classified as a modified and disturbed benthic foreshore and marine habitat of low ecological value. The proposed scope of works as such will have a negligible potential impact on these habitats, its resources and is acceptable.

4.3 Potential Impact Mitigation Measures

The potential impact of increased suspended sediment levels from the works for all docks and ramp can be further minimized through implementation of the following mitigation measures during the construction phase of the project:

- Ensure due diligence when operating machinery during all work activities to prevent and manage petrochemical spillage and contamination of the waters associated with the project sites.

Due to the existing marine benthic environment and water circulation patterns associated with the docks in Arno, Jaluit and Wotje and the Wotje ramp it is not recommended to use silt curtains during constructions. The water current during tidal exchange will transport and allow suspended sediment to disperse throughout the adjacent waters, which are predominately sand lagoon sea floor significantly reducing potential sediment impacts on the live biota, especially hard corals.

The contractor will be required to ensure all equipment is properly maintained and to follow all necessary precautions to prevent spillage of petrochemicals into the marine environment. Provided such measures are properly implemented the potential impacts on the marine environment will be insignificant.

The overall potential impact of the works on the marine biological environment is expected to be minor, localized and overall insignificant provided standard mitigation measures associated with good engineering practice as identified above are implemented. Furthermore due to the nature of potential minor impacts of the scope of works it is recommended that no specific marine monitoring program is required other than close supervision of the works to ensure that the above recommended mitigation measures are implemented and effective throughout the marine construction works. There is no biological justification to relocate hard coral colonies that may be impacted by the projects scope of works.

5 BIBLIOGRAPHY

English, S., Wilkinson, C. & Baker, V., (Ed). 1997. Survey manual for Tropical Marine Resources, 2nd Edition. Australian Institute of Marine Science publication. 390pp.

A2 Water quality and sediment quality testing July 2023

Overview

Sediment and water sampling was undertaken at two sites (1) Arno Dock and (2) Delap Port, Majuro. At each site, samples from four locations were recovered. Physical and chemical analysis of the samples was undertaken. The following sets out the findings of the laboratory analysis of the sediment and water samples.

Physical Analysis of Sediment

One representative sample from each site was recovered. Particle size distribution (PSD) analysis was undertaken by ALS. **Figure 1** presents a summary of the PSD results. Sediment texture results are summarised **Figure 2**.

Results of the PSD analysis indicates that the physical properties of the samples from Arno Dock and Delap Port are distinctly different. The representative sample from Arno Dock consisted of a sandy silt with no gravel content while the representative sample from Delap Port comprised a gravelly sand with only 5% fines.

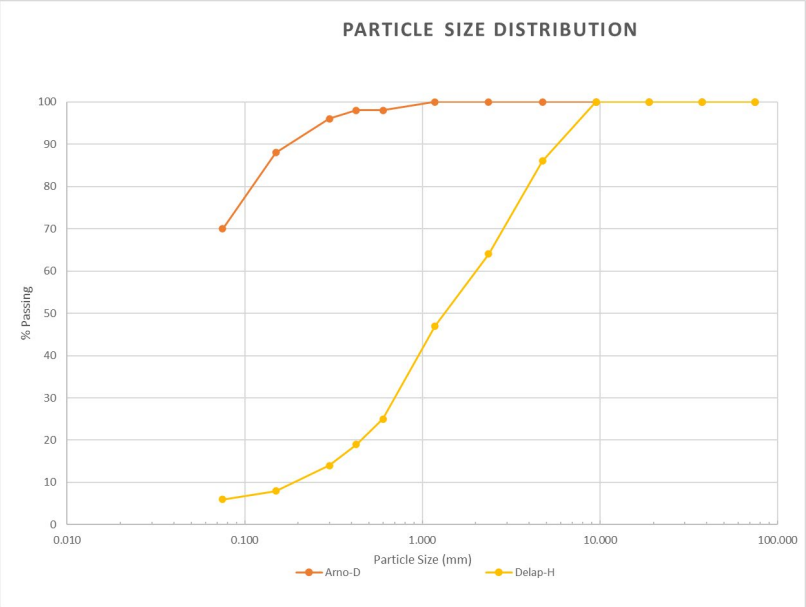


Figure 1 Particle size distribution results

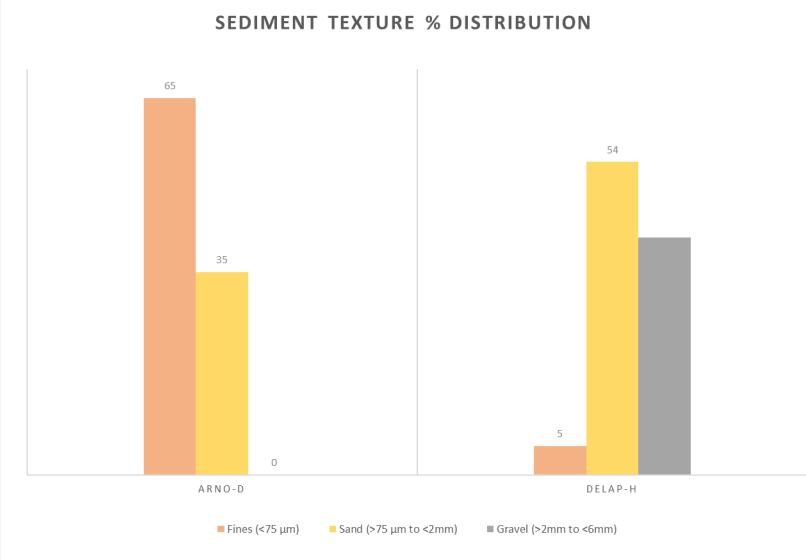


Figure 2 Graphical presentation of sediment texture percentage distribution for representative sample

Chemical Analysis of Sediment

The results of the chemical analysis of samples from Arno Dock and Delap Port have been summarised in the table below. The results have been compared to the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG) 2018 which provides toxicant default guideline values (DGVs) for sediment. ANZG (2018) DGVs are equivalent to the screening levels provided in the Australian National Assessment Guidelines for Dredging (NAGD 2009). The sediment DGVs indicate the concentrations below which there is a low risk of unacceptable effects occurring to aquatic ecosystems.

The results show all sediment samples from Arno Dock had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested indicating a low risk of impacts to the aquatic ecosystem due to disturbance of these sediments.

The sediment samples from Delap Port had low concentrations of the majority of heavy metals, PAHS, PCBs and OC pesticides either below laboratory detection or below the DGVs. However, some samples had elevated concentrations of antimony, lead, zinc, TPHs and TBT above the DGVs and one sample exceeded the ANZG High Guideline Value (GL-High) for zinc indicating there may be some risk of impacts to aquatic ecosystem due to disturbance of these sediments.

Depending on the proposed activities at Delap Port, further assessment adopting multiple lines of evidence is recommended.

Table 1 Sediment quality results

	Unit	LOR	ANZG 2018 Toxicant DGVs (NAGD Screening Level)	ANZG 2018 Toxicant GV-High	Arno Dock				Delap Port			
					Arno-A	Arno-B	Arno-C	Arno-D	Delap-E	Delap-F	Delap-G	Delap-H
Metals												
Aluminium	mg/kg	50			<50	<50	<50	70	2750	560	80	100
Antimony	mg/kg	0.5	2	25	<0.50	<0.50	<0.50	<0.50	3.09	2.03	<0.50	<0.50
Arsenic	mg/kg	1	20	70	<1.00	<1.00	<1.00	1.12	18	9.4	3.52	1.99
Cadmium	mg/kg	0.1	1.5	10	<0.1	<0.1	<0.1	<0.1	1	0.1	<0.1	0.1
Chromium (III+VI)	mg/kg	1	80	370	1.6	3.4	1.3	6.5	59.6	9.2	11.5	30.6
Cobalt	mg/kg	0.5			<1.0	1	<1.0	3.7	405	50.8	11.6	200
Copper	mg/kg	1	65	270	<0.5	<0.5	<0.5	<0.5	6.9	2.5	0.9	<0.5
Iron	mg/kg	50			90	50	160	230	37900	10400	17400	2600
Lead	mg/kg	1	50	220	3.4	1.4	1.4	2	154	23.4	13.7	3.6
Manganese	mg/kg	10			<10	19	<10	45	199	51	96	24
Mercury	mg/kg	0.01	0.15	1	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01
Nickel	mg/kg	1	21	52	<1.0	<1.0	<1.0	<1.0	18	4.2	3.3	1.3
Selenium	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1
Silver	mg/kg	0.1	1	4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	mg/kg	2			<2.0	<2.0	<2.0	<2.0	19	5.9	6.2	2.6
Zinc	mg/kg	1	200	410	1.9	1.9	2	3.9	708	229	47.8	35.1
Organics												
PAHs (Sum of total)*	µg/kg	4	10000	50000	<4	<4	<4	<4	1434	<4	<4	83
PCBs (Sum of total)*	µg/kg	5	34	280	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Tributyltin as SN*	µg Sn/kg	0.5	9	70	----	----	----	<0.5	----	----	----	13.5
TPH C10-C36	mg/kg	3	280	550	14	34	18	23	452	67	36	398
Organochlorine Pesticides												
4,4-DDE	µg/kg	0.5	1.4	7	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chlordane	µg/kg	0.25	4.5	9	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
DDT	µg/kg	0.5	1.2	5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dieldrin	µg/kg	0.5	2.8	7	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Endrin	µg/kg	0.5	2.2	6	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Environmental Standard: Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG), 2018, (ANZG Toxicant default guideline values for sediment quality [DGVs])

*organics have been normalised to 1 per cent total organic carbon.

LOR - Limit of Reporting

Water Quality Analysis

The results of the laboratory chemical analysis of water samples from Arno Dock and Delap Port have been summarised in the table below. The results have been compared to the ANZG (2018) which provides toxicant DGVs for marine water quality. DGVs with a species protection level of 95% is recommended for application to slightly to moderately disturbed ecosystems. The DGVs represent the current best estimates of the concentrations of toxicants that should have no significant adverse effects on the aquatic ecosystem. A DGV is not available for all parameters tested.

The results show all sediment samples from Arno Dock and Delap Port had low concentrations of contaminants either below laboratory detection or below the DGVs for all parameters tested except copper.

Table 1 Water quality results

	Unit	LOR	ANZG 2018 Toxicant DGVs 95% Species Protection	Arno Dock				Delap Port			
				Arno-A	Arno-B	Arno-C	Arno-D	Delap-E	Delap-F	Delap-G	Delap-H
Metals											
Antimony	µg/kg	1		0.6	0.6	<0.5	0.5	0.6	<0.5	<0.5	0.7
Arsenic	µg/kg	0.5		1.9	1.9	1.9	2	1.9	2	2	1.9
Beryllium	µg/kg	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	µg/kg	100.0		4880	4940	4970	4820	4870	4660	4870	4770
Cadmium	µg/kg	0	5.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	µg/kg	0.5	27	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt	µg/kg	0	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Copper	µg/kg	1	1.3	<1	9	<1	7	<1	<1	<1	10
Lead	µg/kg	0	4.4	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Manganese	µg/kg	1	80	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4
Molybdenum	µg/kg	0.10		11.6	11.7	11.8	11.9	11.7	12.4	11.8	12.2
Nickel	µg/kg	1	70	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	4.8
Selenium	µg/kg	2.0		<2	<2	<2	<2	<2	<2	<2	<2
Silver	µg/kg	0.1	1.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/kg	5		<5	<5	<5	<5	<5	<5	<5	<5
Zinc	µg/kg	5	8	<5	<5	<5	<5	<5	<5	<5	<5

LOR – Limit of Reporting
ANZG 2018 WQ-DGV - Australian and New Zealand Guidelines For Fresh And Marine Water Quality (2018), Water Quality – Default Guideline Value for marine water
Level of species protection - 95% Recommended for application for slightly to moderately disturbed ecosystems.

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES2324525**	Page	: 1 of 10
Client	: **HASKONING AUSTRALIA- ROYAL HASKONING**	Laboratory	: Environmental Division Sydney
Contact	: ASHVITTHA SANTHASEELAN	Telephone	: +61-2-8784 8555
Project	: PA3000 RMI Maritime Investment Project	Date Samples Received	: 19-Jul-2023
Site	: ----	Issue Date	: 18-Aug-2023
Sampler	: David Kunst	No. of samples received	: 17
Order number	: ----	No. of samples analysed	: 16

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.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, 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
Matrix Spike (MS) Recoveries							
EP090: Organotin Compounds	ES2324525--016	Delap-H-SED	**Monobutyltin**	78763-54-9	5.8 %	20.0-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	----	----	----	26-Jul-2023	16-Jul-2023	**10**
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						
EP003: Total Organic Carbon (TOC) in Soil							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	15-Aug-2023	30-Jul-2023	**16**	15-Aug-2023	30-Jul-2023	**16**
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-F-SED,	Delap-G-SED						
Soil Glass Jar - Unpreserved							
Delap-E-SED,	Delap-H-SED	24-Jul-2023	16-Jul-2023	**8**	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-F-SED,	Delap-G-SED						
Soil Glass Jar - Unpreserved							
Delap-E-SED,	Delap-H-SED	24-Jul-2023	16-Jul-2023	**8**	----	----	----
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved							
Delap-H-SED		26-Jul-2023	16-Jul-2023	**10**	----	----	----
Soil Glass Jar - Unpreserved							
Arno-D-SED		26-Jul-2023	16-Jul-2023	**10**	----	----	----
EP130A: Organophosphorus Pesticides (Ultra-trace)							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EP130A: Organophosphorus Pesticides (Ultra-trace) - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						
EP131A: Organochlorine Pesticides							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						
EP131B: Polychlorinated Biphenyls (as Aroclors)							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved							
Arno-A-SED,	Arno-B-SED,	24-Jul-2023	16-Jul-2023	**8**	----	----	----
Arno-C-SED,	Arno-D-SED,						
Delap-E-SED,	Delap-F-SED,						
Delap-G-SED,	Delap-H-SED						

Analysis Holding Time Compliance

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.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**----**	----	----	**26-Jul-2023**	16-Jul-2023	×
EA150: Particle Sizing							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
Arno-D-SED, Delap-H-SED	**02-Jul-2023**	**----**	----	----	**18-Aug-2023**	29-Dec-2023	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
Arno-D-SED, Delap-H-SED	**02-Jul-2023**	**----**	----	----	**18-Aug-2023**	29-Dec-2023	✓
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**26-Jul-2023**	29-Dec-2023	✓	**27-Jul-2023**	29-Dec-2023	✓
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**26-Jul-2023**	29-Dec-2023	✓	**27-Jul-2023**	29-Dec-2023	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T-LL)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**26-Jul-2023**	30-Jul-2023	✓	**27-Jul-2023**	30-Jul-2023	✓
EP003: Total Organic Carbon (TOC) in Soil							
Soil Glass Jar - Unpreserved (EP003)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**15-Aug-2023**	30-Jul-2023	×	**15-Aug-2023**	30-Jul-2023	×

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071-SD-SV)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-F-SED, Delap-G-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**29-Jul-2023**	02-Sep-2023	✓
Soil Glass Jar - Unpreserved (EP071-SD-SV)							
Delap-E-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**31-Jul-2023**	02-Sep-2023	✓
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071-SD-SV)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-F-SED, Delap-G-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**29-Jul-2023**	02-Sep-2023	✓
Soil Glass Jar - Unpreserved (EP071-SD-SV)							
Delap-E-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**31-Jul-2023**	02-Sep-2023	✓
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved (EP090)							
Delap-H-SED	**02-Jul-2023**	**26-Jul-2023**	16-Jul-2023	×	**27-Jul-2023**	04-Sep-2023	✓
Soil Glass Jar - Unpreserved (EP090)							
Arno-D-SED	**02-Jul-2023**	**26-Jul-2023**	16-Jul-2023	×	**28-Jul-2023**	04-Sep-2023	✓
EP130A: Organophosphorus Pesticides (Ultra-trace)							
Soil Glass Jar - Unpreserved (EP130)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**30-Jul-2023**	02-Sep-2023	✓
EP131A: Organochlorine Pesticides							
Soil Glass Jar - Unpreserved (EP131A)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**29-Jul-2023**	02-Sep-2023	✓
EP131B: Polychlorinated Biphenyls (as Aroclors)							
Soil Glass Jar - Unpreserved (EP131B)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**28-Jul-2023**	02-Sep-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP132B-SD)							
Arno-A-SED, Arno-B-SED, Arno-C-SED, Arno-D-SED, Delap-E-SED, Delap-F-SED, Delap-G-SED, Delap-H-SED	**02-Jul-2023**	**24-Jul-2023**	16-Jul-2023	×	**01-Aug-2023**	02-Sep-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG093T: Total Metals in Saline Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG093B-T)							
Arno-A-WAT, Arno-B-WAT, Arno-C-WAT, Arno-D-WAT, Delap-E-WAT, Delap-F-WAT, Delap-G-WAT, Delap-H-WAT	**02-Jul-2023**	**27-Jul-2023**	29-Dec-2023	✓	**27-Jul-2023**	29-Dec-2023	✓

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)							
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fractions Only	EP071-SD-SV	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Organochlorine Pesticides (Ultra-trace)	EP131A	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fractions Only	EP071-SD-SV	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Organochlorine Pesticides (Ultra-trace)	EP131A	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fractions Only	EP071-SD-SV	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Organochlorine Pesticides (Ultra-trace)	EP131A	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	8	**12.50**	**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*	
Matrix Spikes (MS) - Continued							
Organotin Analysis	EP090	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fractions Only	EP071-SD-SV	1	8	**12.50**	**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*	
Laboratory Duplicates (DUP)							
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	1	8	**12.50**	**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
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 Fe and Al in Sediments by ICPAES	EG005-SD	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). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	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. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(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 SnCl2 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 Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automatically measured by infra-red detector.
TPH - Semivolatile Fractions Only	EP071-SD-SV	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270 Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
Organophosphorus Pesticides (Ultra-trace)	EP130	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup), 8141 (GC/FPD - Capillary Column) This technique is compliant with NEPM Schedule B(3)
Organochlorine Pesticides (Ultra-trace)	EP131A	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/µECD/µECD) This technique is compliant with NEPM Schedule B(3)
PCB's (Ultra-trace)	EP131B	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/µECD/µECD) This technique is compliant with NEPM Schedule B(3)
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	In house: Referenced to USEPA 8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.
Total Metals in Saline Water Suite A by ORC-ICPMS	EG093A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM Schedule B(3).

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
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).
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
Tumbler Extraction of Solids (Option A - Concentrating)	ORG17A	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Tumbler Extraction of Solids/ Sample Cleanup	ORG17A-UTP	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. Samples are extracted, concentrated (by KD) and exchanged into an appropriate solvent for GPC and florisil cleanup as required.
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na2SO4 and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	In house: 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.
Digestion for Total Recoverable Metals - ORC	EN25-ORC	WATER	In house: Referenced to USEPA SW846-3005. This is an Ultrapure Nitric acid digestion procedure used to prepare surface and ground water samples for analysis by ORC- ICPMS. This method is compliant with NEPM Schedule B(3)

A3 Soil contamination testing July 2023

Overview

Soil sampling was undertaken at Ebeye and Delap from five test pits as part of geotechnical investigation by Tonkin Taylor International. Samples from the test pits were recovered at varying depths of 0.1 m, 0.3 m and 0.75 m. Review of the test pit logs indicate the soil is a fine to coarse gravelly sand derived from coral. Chemical analysis of the samples was undertaken for heavy metals, BTEX, petroleum hydrocarbon (TPH), polycyclic aromatic hydrocarbons (PAH) and asbestos. The following sets out the findings of the laboratory analysis of the soil samples.

Chemical Analysis of Soil

The results of the chemical analysis of samples have been summarised in the table below. The results have been compared to Australian and New South Wales (NSW) guidelines:

- NSW Waste Classification Guidelines: Part 1 Classifying waste (NSW EPA 2014)
- National Environmental Protection Measure (NEPM) (2013)

Results were screened against relevant assessment criteria to inform the potential impact to human health from reuse of the soil and provide a preliminary waste classification in the case that excavated soil requires disposal at an offsite waste facility. The assessment criteria adopted is summarised in **Table 1** below.

Table 1 Adopted soil assessment criteria

Assessment Criteria	Description and relevance
NEPM human health investigation level (HIL) D	Non-volatile (i.e., metals) and semi-volatile organic compound (PAHs) acceptance criteria for human health exposure in a commercial/ industrial land use setting.
NEPM human health screening level (HSL) D	Volatile organic compound (TRH, BTEXN etc.) acceptance criteria for human health exposure in a commercial/ industrial land use setting.
NSW Waste Classification	Material classification acceptance criteria for disposal at a licensed waste facility.

Soil analytical results were screened against adopted assessment criteria. Tabulated soil quality results are presented in **Table 2** below.

Table 2 Soil quality results

Sample Name		Metals							Asbestos	BTEX				PAH			TPH	
		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc		Benzene	Toluene	Ethylbenzene	Xylene	Total PAHs	Benzo[a]pyrene	Naphthalene	C7 - C9	C7 - C36
	units dry weight	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
NSW 2014 General Solid Waste CT1 (No Leaching)		100	20			100	40			10	288	600	1000	200	0.8			
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil		3,000	800		240,000	1,500	6,000	400,000						4,000				
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL Vapour intrusion,Sand										3			230				260	
TP3 - 0.1m Ebeye 03-Jul-2023		3	0.13	7	28	5.1	4	114	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP3 - 0.3m Ebeye 03-Jul-2023		< 5	< 0.3	< 5	< 5	1.9	< 5	9	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP6 - 0.1m Delap 28-Jun-2023		3	0.11	5	10	2.7	2	50	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	620
TP8 - 0.1m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	0.9	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP8 - 0.3m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP8 - 0.75m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP9 - 0.1m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP9 - 0.75m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP11 - 0.1m Delap 28-Jun-2023		3	0.26	22	24	25	8	144	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	0.012	< 0.06	< 20	125
TP11 - 0.3m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80
TP11 - 0.75m Delap 28-Jun-2023		< 2	< 0.10	< 2	< 2	< 0.4	< 2	< 4	Not Detected	< 0.05	< 0.05	< 0.05	< 0.10	< 0.3	< 0.011	< 0.06	< 20	< 80

Key Findings

The soil samples from Ebeye and Delap had low concentrations of the majority of heavy metals, PAHs, BTEX and TPH pesticides either below laboratory detection or below the assessment criteria. Contaminants detected above the laboratory detection limits were primarily observed in the samples at 0.1 m.

No contaminants were reported above the adopted human health assessment criteria at locations sampled. Minor detections of select TPH fractions, heavy metals and PAHs were reported, however, not at concentrations likely to impact reuse of the soil.

The results showed all samples did not exceed the adopted contaminant threshold 1 (CT1) waste criteria, indicating these samples can be classified as General Solid Waste (non-putrescible).

Asbestos was not identified in any sample collected, indicating the soil assessed is not classified as special waste under the EPA NSW Waste Classification guideline definition.

This preliminary waste classification is based on limited information only. If spoil requires disposal offsite, further waste classification should be conducted during the construction phase to confirm the classification. Where soils cannot be reused under appropriate beneficial reuse conditions, soil could be disposed of offsite to a waste facility.

An unexpected finds protocol (UFP) should be prepared as part of the construction environmental management plan (CEMP) so that any identified contamination is managed appropriately during construction.

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	3324786 SPv1
Contact:	Zach Frame	**Date Received:**	19-Jul-2023
	PO Box 5271	**Date Reported:**	01-Aug-2023
	Victoria Street West	**Quote No:**	124657
	Auckland 1141	**Order No:**	1015910
		Client Reference:	1015910 (Marshall Islands Testing)
		Submitted By:	Zach Frame

Sample Type: Soil

Sample Name:		TP3 - 0.1m Ebeye 03-Jul-2023	TP3 - 0.3m Ebeye 03-Jul-2023	TP6 - 0.1m Delap 28-Jun-2023	TP8 - 0.1m Delap 28-Jun-2023	TP8 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.1	3324786.2	3324786.3	3324786.4	3324786.5
Individual Tests						
Dry Matter	g/100g as rcvd	93	92	94	92	92
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	< 5	3	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	0.13	< 0.3	0.11	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	7	< 5	5	< 2	< 2
Total Recoverable Copper	mg/kg dry wt	28	< 5	10	< 2	< 2
Total Recoverable Lead	mg/kg dry wt	5.1	1.9	2.7	0.9	< 0.4
Total Recoverable Nickel	mg/kg dry wt	4	< 5	2	< 2	< 2
Total Recoverable Zinc	mg/kg dry wt	114	9	50	< 4	< 4
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.025	< 0.027	< 0.025	< 0.026	< 0.026
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.025	< 0.026	< 0.025	< 0.026	< 0.026
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011

Sample Type: Soil						
Sample Name:		TP3 - 0.1m Ebeye 03-Jul-2023	TP3 - 0.3m Ebeye 03-Jul-2023	TP6 - 0.1m Delap 28-Jun-2023	TP8 - 0.1m Delap 28-Jun-2023	TP8 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.1	3324786.2	3324786.3	3324786.4	3324786.5
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	620	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	620	< 80	< 80

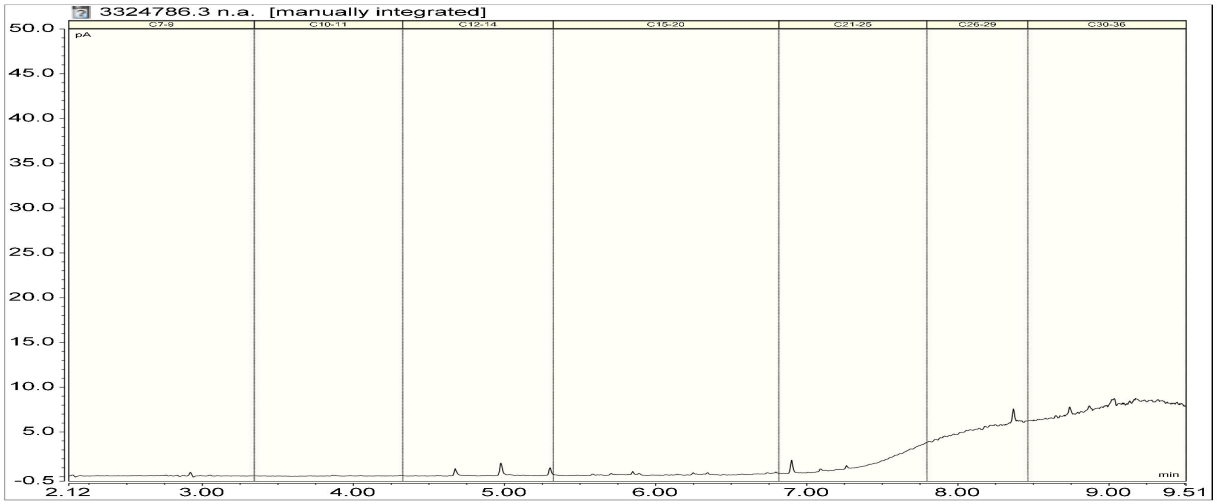
Sample Name:		TP8 - 0.75m Delap 28-Jun-2023	TP9 - 0.1m Delap 28-Jun-2023	TP9 - 0.75m Delap 28-Jun-2023	TP11 - 0.1m Delap 28-Jun-2023	TP11 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.6	3324786.7	3324786.8	3324786.9	3324786.10
Individual Tests						
Dry Matter	g/100g as rcvd	90	92	93	90	92
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2	3	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.26	< 0.10
Total Recoverable Chromium	mg/kg dry wt	< 2	< 2	< 2	22	< 2
Total Recoverable Copper	mg/kg dry wt	< 2	< 2	< 2	24	< 2
Total Recoverable Lead	mg/kg dry wt	< 0.4	< 0.4	< 0.4	25	< 0.4
Total Recoverable Nickel	mg/kg dry wt	< 2	< 2	< 2	8	< 2
Total Recoverable Zinc	mg/kg dry wt	< 4	< 4	< 4	144	< 4
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.012	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.027	< 0.026	< 0.026	< 0.027	< 0.026
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.027	< 0.026	< 0.026	< 0.027	< 0.026
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.022	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011

Sample Type: Soil						
Sample Name:		TP8 - 0.75m Delap 28-Jun-2023	TP9 - 0.1m Delap 28-Jun-2023	TP9 - 0.75m Delap 28-Jun-2023	TP11 - 0.1m Delap 28-Jun-2023	TP11 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.6	3324786.7	3324786.8	3324786.9	3324786.10
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	< 40	121	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 80	125	< 80

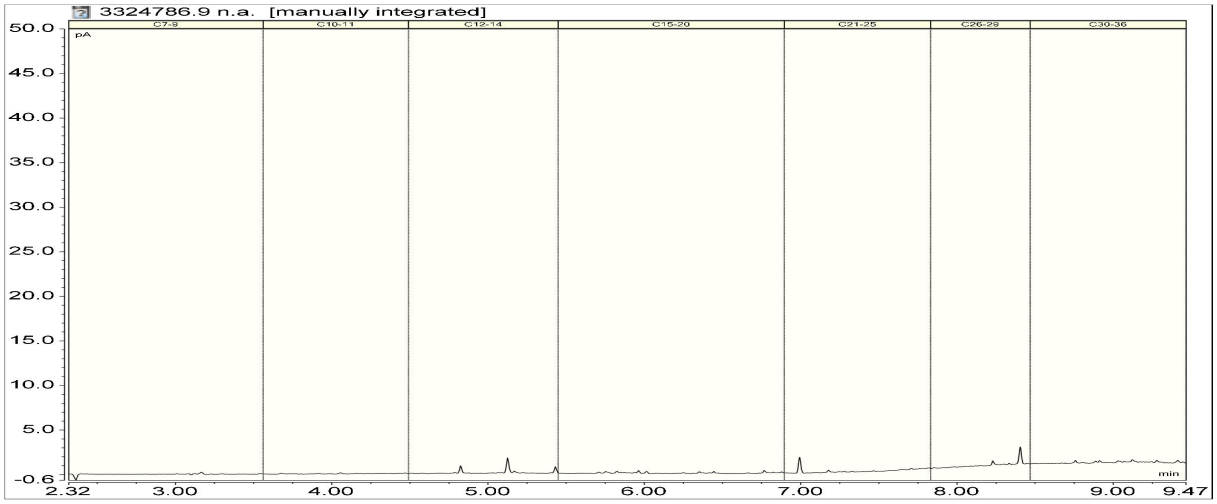
Sample Name:		TP11 - 0.75m Delap 28-Jun-2023
Lab Number:		3324786.11
Individual Tests		
Dry Matter	g/100g as rcvd	90
Heavy Metals, Screen Level		
Total Recoverable Arsenic	mg/kg dry wt	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10
Total Recoverable Chromium	mg/kg dry wt	< 2
Total Recoverable Copper	mg/kg dry wt	< 2
Total Recoverable Lead	mg/kg dry wt	< 0.4
Total Recoverable Nickel	mg/kg dry wt	< 2
Total Recoverable Zinc	mg/kg dry wt	< 4
BTEX in Soil by Headspace GC-MS		
Benzene	mg/kg dry wt	< 0.05
Toluene	mg/kg dry wt	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10
o-Xylene	mg/kg dry wt	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil*		
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011
Acenaphthylene	mg/kg dry wt	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011
Anthracene	mg/kg dry wt	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.027
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.026
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011
Chrysene	mg/kg dry wt	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011
Fluorene	mg/kg dry wt	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011
Naphthalene	mg/kg dry wt	< 0.06
Perylene	mg/kg dry wt	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011
Pyrene	mg/kg dry wt	< 0.011
Total Petroleum Hydrocarbons in Soil		
C7 - C9	mg/kg dry wt	< 20
C10 - C14	mg/kg dry wt	< 20

Sample Type: Soil		
Sample Name:		TP11 - 0.75m Delap 28-Jun-2023
Lab Number:		3324786.11
Total Petroleum Hydrocarbons in Soil		
C15 - C36	mg/kg dry wt	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80

3324786.3
TP6 - 0.1m Delap 28-Jun-2023
Client Chromatogram for TPH by FID



3324786.9
TP11 - 0.1m Delap 28-Jun-2023
Client Chromatogram for TPH by FID



Analyst's Comments

It was observed that the container(s) for sample(s) {3324786.1,2,3,4,5,6,7,8,9,10,11} were not completely filled. Volatile loss may have occurred due to the headspace created in the container. - 28-07-23

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request.
Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-11

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total of Reported PAHs in Soil	Sonication extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	1-11
Dry Matter	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-11
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	BaP Potency Equivalence calculated from; Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1.0 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.024 mg/kg dry wt	1-11
Benzo[a]pyrene Toxic Equivalence (TEF)*	Benzo[a]pyrene Toxic Equivalence (TEF) calculated from; Benzo[a]pyrene x 1.0 + Benzo(a)anthracene x 0.1 + Benzo(b) fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.024 mg/kg dry wt	1-11
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-11
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis. Tested on as received sample. In-house based on US EPA 8260 and 5021.	0.05 - 0.10 mg/kg dry wt	1-11
Polycyclic Aromatic Hydrocarbons Screening in Soil*	Sonication extraction, GC-MS/MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.010 - 0.05 mg/kg dry wt	1-11
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	3, 9
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	1-11
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	1-11
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	1-11
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	1-11

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 28-Jul-2023 and 01-Aug-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	3324786 SPv2
Contact:	Zach Frame	**Date Received:**	19-Jul-2023
	PO Box 5271	**Date Reported:**	16-Aug-2023 **(Amended)**
	Victoria Street West	**Quote No:**	124657
	Auckland 1141	**Order No:**	1015910
		Client Reference:	1015910 (Marshall Islands Testing)
		Submitted By:	Zach Frame

Sample Type: Soil

Sample Name:	TP3 - 0.1m Ebeye 03-Jul-2023	TP3 - 0.3m Ebeye 03-Jul-2023	TP6 - 0.1m Delap 28-Jun-2023	TP8 - 0.1m Delap 28-Jun-2023	TP8 - 0.3m Delap 28-Jun-2023
Lab Number:	3324786.1	3324786.2	3324786.3	3324786.4	3324786.5
Individual Tests					
Dry Matter g/100g as rcvd	93	92	94	92	92
Heavy Metals, Screen Level					
Total Recoverable Arsenic mg/kg dry wt	3	< 5	3	< 2	< 2
Total Recoverable Cadmium mg/kg dry wt	0.13	< 0.3	0.11	< 0.10	< 0.10
Total Recoverable Chromium mg/kg dry wt	7	< 5	5	< 2	< 2
Total Recoverable Copper mg/kg dry wt	28	< 5	10	< 2	< 2
Total Recoverable Lead mg/kg dry wt	5.1	1.9	2.7	0.9	< 0.4
Total Recoverable Nickel mg/kg dry wt	4	< 5	2	< 2	< 2
Total Recoverable Zinc mg/kg dry wt	114	9	50	< 4	< 4
Asbestos in Soil					
As Received Weight Presence / Absence Testing g	148.5	139.4	134.7	175.1	120.8
Dry Weight Presence / Absence Testing g	148.4	139.4	133.7	175.0	120.8
<2mm Subsample Weight Presence / Absence Testing g dry wt	58.1	57.6	54.5	57.7	60.0
Asbestos Presence / Absence from Presence / Absence Testing	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form Presence / Absence Testing	-	-	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil*					
Total of Reported PAHs in Soil mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1-Methylnaphthalene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthylene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Anthracene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]anthracene mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP) mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES* mg/kg dry wt	< 0.025	< 0.027	< 0.025	< 0.026	< 0.026
Benzo[a]pyrene Toxic Equivalence (TEF)* mg/kg dry wt	< 0.025	< 0.026	< 0.025	< 0.026	< 0.026

Sample Type: Soil						
Sample Name:		TP3 - 0.1m Ebeye 03-Jul-2023	TP3 - 0.3m Ebeye 03-Jul-2023	TP6 - 0.1m Delap 28-Jun-2023	TP8 - 0.1m Delap 28-Jun-2023	TP8 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.1	3324786.2	3324786.3	3324786.4	3324786.5
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	620	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	620	< 80	< 80

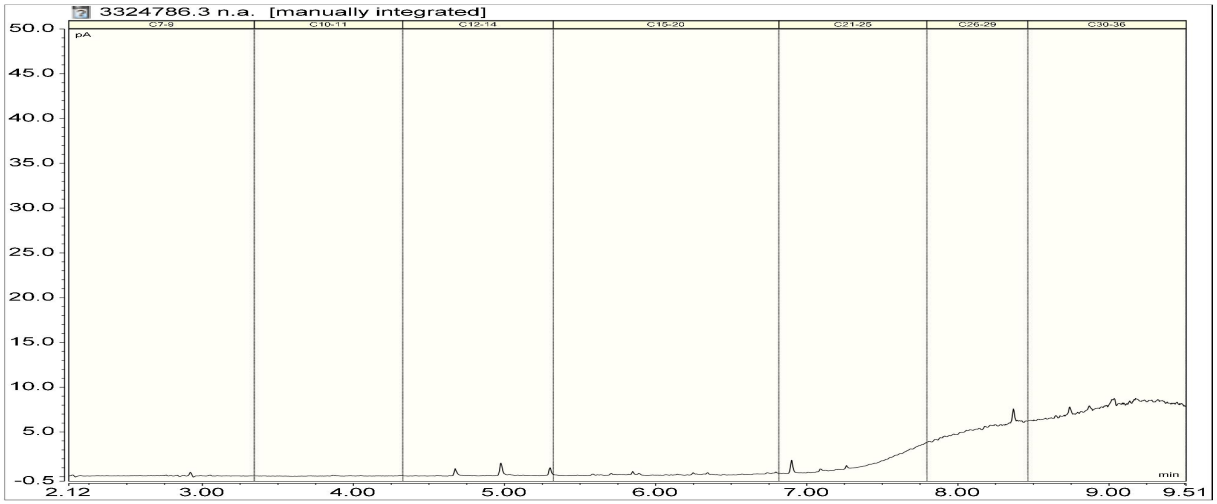
Sample Name:		TP8 - 0.75m Delap 28-Jun-2023	TP9 - 0.1m Delap 28-Jun-2023	TP9 - 0.75m Delap 28-Jun-2023	TP11 - 0.1m Delap 28-Jun-2023	TP11 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.6	3324786.7	3324786.8	3324786.9	3324786.10
Individual Tests						
Dry Matter	g/100g as rcvd	90	92	93	90	92
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2	3	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.26	< 0.10
Total Recoverable Chromium	mg/kg dry wt	< 2	< 2	< 2	22	< 2
Total Recoverable Copper	mg/kg dry wt	< 2	< 2	< 2	24	< 2
Total Recoverable Lead	mg/kg dry wt	< 0.4	< 0.4	< 0.4	25	< 0.4
Total Recoverable Nickel	mg/kg dry wt	< 2	< 2	< 2	8	< 2
Total Recoverable Zinc	mg/kg dry wt	< 4	< 4	< 4	144	< 4
Asbestos in Soil						
As Received Weight Presence / Absence Testing	g	122.0	113.5	141.8	160.1	110.4
Dry Weight Presence / Absence Testing	g	122.0	113.4	141.8	160.0	110.4
<2mm Subsample Weight Presence / Absence Testing	g dry wt	54.4	55.0	55.6	56.1	57.8
Asbestos Presence / Absence from Presence / Absence Testing		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form Presence / Absence Testing		-	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011

Sample Type: Soil						
Sample Name:		TP8 - 0.75m Delap 28-Jun-2023	TP9 - 0.1m Delap 28-Jun-2023	TP9 - 0.75m Delap 28-Jun-2023	TP11 - 0.1m Delap 28-Jun-2023	TP11 - 0.3m Delap 28-Jun-2023
Lab Number:		3324786.6	3324786.7	3324786.8	3324786.9	3324786.10
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Benzo[a]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.012	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.027	< 0.026	< 0.026	< 0.027	< 0.026
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.027	< 0.026	< 0.026	< 0.027	< 0.026
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.022	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	0.014	< 0.011
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	< 40	121	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 80	125	< 80

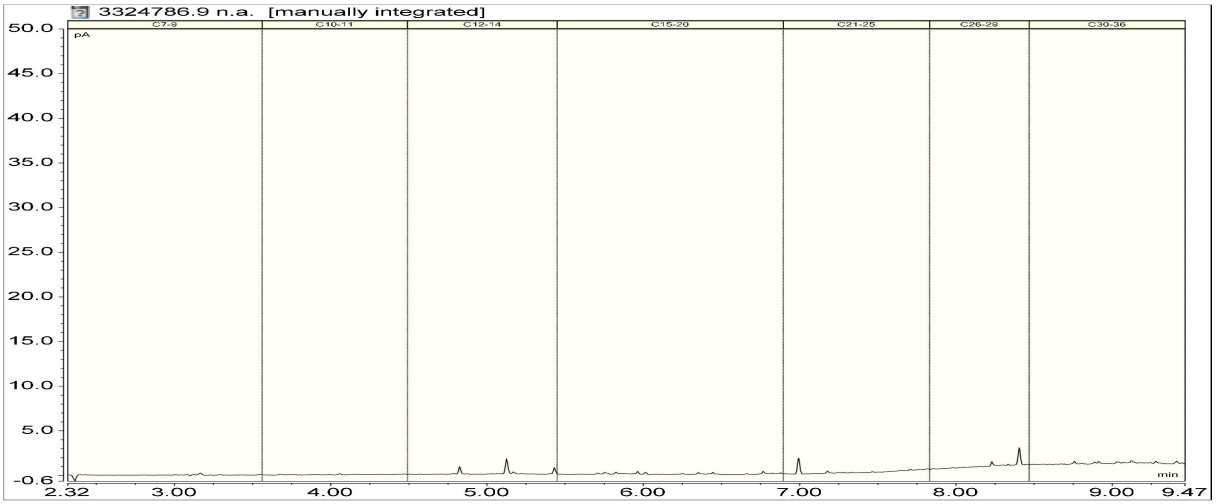
Sample Name:		TP11 - 0.75m Delap 28-Jun-2023
Lab Number:		3324786.11
Individual Tests		
Dry Matter	g/100g as rcvd	90
Heavy Metals, Screen Level		
Total Recoverable Arsenic	mg/kg dry wt	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10
Total Recoverable Chromium	mg/kg dry wt	< 2
Total Recoverable Copper	mg/kg dry wt	< 2
Total Recoverable Lead	mg/kg dry wt	< 0.4
Total Recoverable Nickel	mg/kg dry wt	< 2
Total Recoverable Zinc	mg/kg dry wt	< 4
Asbestos in Soil		
As Received Weight Presence / Absence Testing	g	127.2
Dry Weight Presence / Absence Testing	g	127.2
<2mm Subsample Weight Presence / Absence Testing	g dry wt	58.7
Asbestos Presence / Absence from Presence / Absence Testing		Asbestos NOT detected.
Description of Asbestos Form Presence / Absence Testing		-
BTEX in Soil by Headspace GC-MS		
Benzene	mg/kg dry wt	< 0.05
Toluene	mg/kg dry wt	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10
o-Xylene	mg/kg dry wt	< 0.05

Sample Type: Soil		
Sample Name:		TP11 - 0.75m Delap 28-Jun-2023
Lab Number:		3324786.11
Polycyclic Aromatic Hydrocarbons Screening in Soil*		
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011
Acenaphthylene	mg/kg dry wt	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011
Anthracene	mg/kg dry wt	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.027
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.026
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011
Chrysene	mg/kg dry wt	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011
Fluoranthene	mg/kg dry wt	< 0.011
Fluorene	mg/kg dry wt	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011
Naphthalene	mg/kg dry wt	< 0.06
Perylene	mg/kg dry wt	< 0.011
Phenanthrene	mg/kg dry wt	< 0.011
Pyrene	mg/kg dry wt	< 0.011
Total Petroleum Hydrocarbons in Soil		
C7 - C9	mg/kg dry wt	< 20
C10 - C14	mg/kg dry wt	< 20
C15 - C36	mg/kg dry wt	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80

3324786.3
TP6 - 0.1m Delap 28-Jun-2023
Client Chromatogram for TPH by FID



3324786.9
TP11 - 0.1m Delap 28-Jun-2023
Client Chromatogram for TPH by FID



Analyst's Comments

It was observed that the container(s) for sample(s) {3324786.1,2,3,4,5,6,7,8,9,10,11} were not completely filled. Volatile loss may have occurred due to the headspace created in the container. - 28-07-23

Amended Report: This certificate of analysis replaces report '3324786-SPv1' issued on 01-Aug-2023 at 4:22 pm. Reason for amendment: Additional testing added as per clients request.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-11
Sample preparation by Non Routine section*	Sample preparation as per test requirement.	-	1-11
Total of Reported PAHs in Soil	Sonication extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	1-11
Dry Matter	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-11
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	BaP Potency Equivalence calculated from; Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1.0 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.024 mg/kg dry wt	1-11
Benzo[a]pyrene Toxic Equivalence (TEF)*	Benzo[a]pyrene Toxic Equivalence (TEF) calculated from; Benzo[a]pyrene x 1.0 + Benzo(a)anthracene x 0.1 + Benzo(b) fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.024 mg/kg dry wt	1-11
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-11
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis. Tested on as received sample. In-house based on US EPA 8260 and 5021.	0.05 - 0.10 mg/kg dry wt	1-11
Polycyclic Aromatic Hydrocarbons Screening in Soil*	Sonication extraction, GC-MS/MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.010 - 0.05 mg/kg dry wt	1-11

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Asbestos in Soil			
As Received Weight Presence / Absence Testing	Measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1-11
Dry Weight Presence / Absence Testing	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1-11
<2mm Subsample Weight Presence / Absence Testing	Sample dried at 100 to 105°C, weight of <2mm sample fraction taken for asbestos identification if less than entire fraction. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	-	1-11
Asbestos Presence / Absence from Presence / Absence Testing	Examination using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including 'Dispersion Staining Techniques'. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	0.01%	1-11
Description of Asbestos Form Presence / Absence Testing	Description of asbestos form and/or shape if present.	-	1-11
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	3, 9
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	1-11
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	1-11
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	1-11
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	1-11

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 28-Jul-2023 and 16-Aug-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Kim Harrison MSc
Client Services Manager - Environmental