Marine Environmental Quality Monitoring and Management Plan

Ashburton Salt Project

ENVIRONMENT
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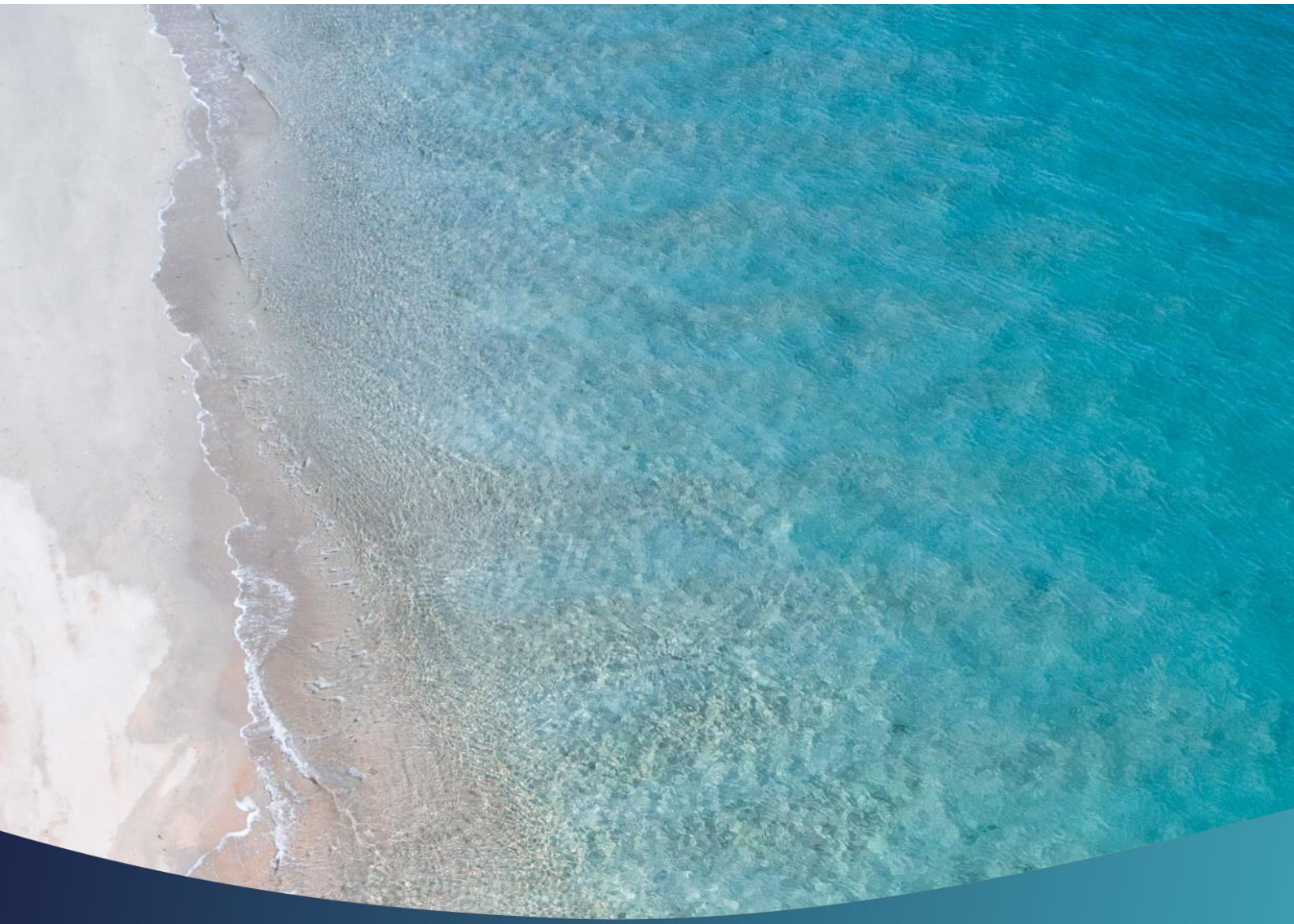

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Acronyms and Abbreviations

Acronyms and Abbreviations	Description
°C	Degrees Celsius
%	Percent
ANZG	Australian and New Zealand Guidelines
ASTM	American Society for Testing Materials
BCH	Benthic Communities and Habitat
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPBC Act	Commonwealth Environmental Protection and Biodiversity Act 1999
EQC	Environmental Quality Criteria
EQI	Environmental Quality Indicator
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
ESD	Environmental Scoping document
EVs	Environmental Values
GLpa	Gigalitre per annuum
GPS	Geographic Positioning System
Km/hr	Kilometres per hour
Ktpa	Kilo tonnes per annum
LEP	Level of Environmental Protection
NTU	Nephelometric Turbidity Units
MEQ	Marine Environmental Quality
MEQMMP	Marine Environmental Quality and Management Plan
MTs	Management Targets
Mtpa	Million tonnes per annum
NaCl	Sodium chloride (commonly known as salt)
O2M	O2 Marine Pty Ltd
ppt	Parts per thousand
QGIS	Quantum Geographic Information System (mapping software package)
SWQMS	State Water Quality Management Strategy
uS/cm	Microsiemens per centimetre

WA	Western Australia
WET	Whole Effluent Toxicity

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1. Introduction

1.1. Project Summary

K plus S Salt Australia Pty Ltd (K+S) propose to develop and operate a greenfield Solar Salt Project (the Project) on the Western Australian coast, approximately 40 km south-west of the townships of Onslow, within the shire of Ashburton (Figure 1). The Project will produce up to 4.7 million tonnes per annum (mtpa) of salt through solar salt farming, a process involving the evaporation of sea water using sunlight and wind.

The proposal includes the construction of the solar evaporation and crystallisation ponds and associated infrastructure including:

- a seawater intake (comprising an intake sump, pipelines, pumps and channel)
- concentration and crystallisation ponds
- salt wash plant
- stockpiles and conveyors
- bitterns discharge infrastructure (including a dilution pond, pipeline and diffuser)
- jetty and product loading infrastructure
- access road, internal site roads and haul roads (for construction materials and, during operations for site maintenance and product transfer)
- borrow pits for extraction of clay and other construction materials
- drainage diversions
- dredging and onshore placement of dredged material
- buildings such as offices, storage and workshops
- sewage treatment
- water monitoring bores
- small desalination plant
- service corridors
- electricity and natural gas distribution
- equipment parking and laydown areas
- fuel storage and a refuelling station
- helipad.

The proposed Project layout is shown in Figure 2. The summary project description is detailed in Table 1, with key physical and operational elements of the Project identified in Table 2.

Table 1 Short Summary of the Proposal

Project Title	Ashburton Salt Project
Proponent Name	K plus S Salt Australia Pty Ltd
Short Description	It is proposed to construct and operate a solar salt Project approximately 40 km southwest of Onslow, WA. The Proposal includes the construction of solar salt evaporation and crystallisation ponds and associated infrastructure/activities (seawater intake pumps /

	channel / pipeline(s); seawater concentration ponds and salt crystallisation ponds; internal site roads; electricity generation and reticulation; fuel storage sites; a jetty and product loading facilities; a salt wash plant and associated ponds; salt stockpiles and conveyors; onsite buildings such as offices, storage, workshops and possibly accommodation; sewage treatment facilities and landfill; water management/monitoring bore(s); helipad; desalination plant; equipment parking and laydown areas; bitterns discharge infrastructure which includes a channel, dilution pond, pipeline and diffuser; drainage diversion/s and levees; access roads; borrow pit areas for rock, clay and other construction materials; and dredging and land based dredge spoil disposal).

Table 2 Location and proposed extent of physical and operational elements

Element	Location	Proposed Extent
Physical Elements		
Evaporation and crystallisation ponds	Figure 2	Disturbance footprint of no more than 10,397 ha within a 20,990 ha Ashburton Salt Project Development Envelope
Support infrastructure	Figure 2	Disturbance footprint of no more than 1,596 ha within a 20,990 ha Ashburton Salt Project (includes: seawater intake pumps/channel/pipeline(s); internal site roads; electricity generation and reticulation; fuel storage sites; a jetty and product loading facilities; dredging; land based dredge spoil disposal; a salt wash plant and associated ponds; salt stockpiles and conveyors; onsite buildings such as offices, storage, workshops and accommodation; sewage treatment facilities; landfill; water management/monitoring bore(s); equipment parking and laydown areas; bitterns discharge infrastructure which includes a channel, dilution pond, pipeline and diffuser; drainage diversion(s) and levees; borrow pits; helipad; and desalination plant.)
Access roads (including road upgrades and river crossing/bridge	Figure 2	Clearing of no more than 155 ha within a 20,990 ha Ashburton Salt Project Development Envelope (77 ha for main access road and 78 ha for internal site access roads)
Operational Elements		
Seawater intake	Figure 2	Seawater intake of no more than 250 GL per annum
Wastewater (bitterns)	Figure 2	Marine discharge of no more than 20 GL per annum (consists of no more than 10 GL per annum bitterns, diluted with seawater at a ratio of approximately 1 to 1)

1.2. Purpose of this Plan

The purpose of this Marine Environmental Quality Monitoring and Management Plan (MEQMMP) is to support environmental approval for the proposal, through demonstration of best-practice environmental management to achieve acceptable Environmental Protection Outcomes (EPOs). Specifically, the plan will:

1. Address the commitment of the Environmental Scoping Document to prepare a Marine Environmental Quality Monitoring and Management Plan (MEQMMP)
2. Provide a comprehensive management and monitoring plan for bitterns discharge
3. Provide an environmental quality plan (based on the Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives (Department of Environment 2006)) identifying the environmental values to be protected, levels of ecological protection, key sensitive biological receptors, and water quality indicators
4. Describe the baseline data acquisition and mapping for ongoing monitoring
5. Provide a Product and bitterns spillage risk assessment and management plan
6. Provide a hydrocarbon spill risk assessment and management plan.

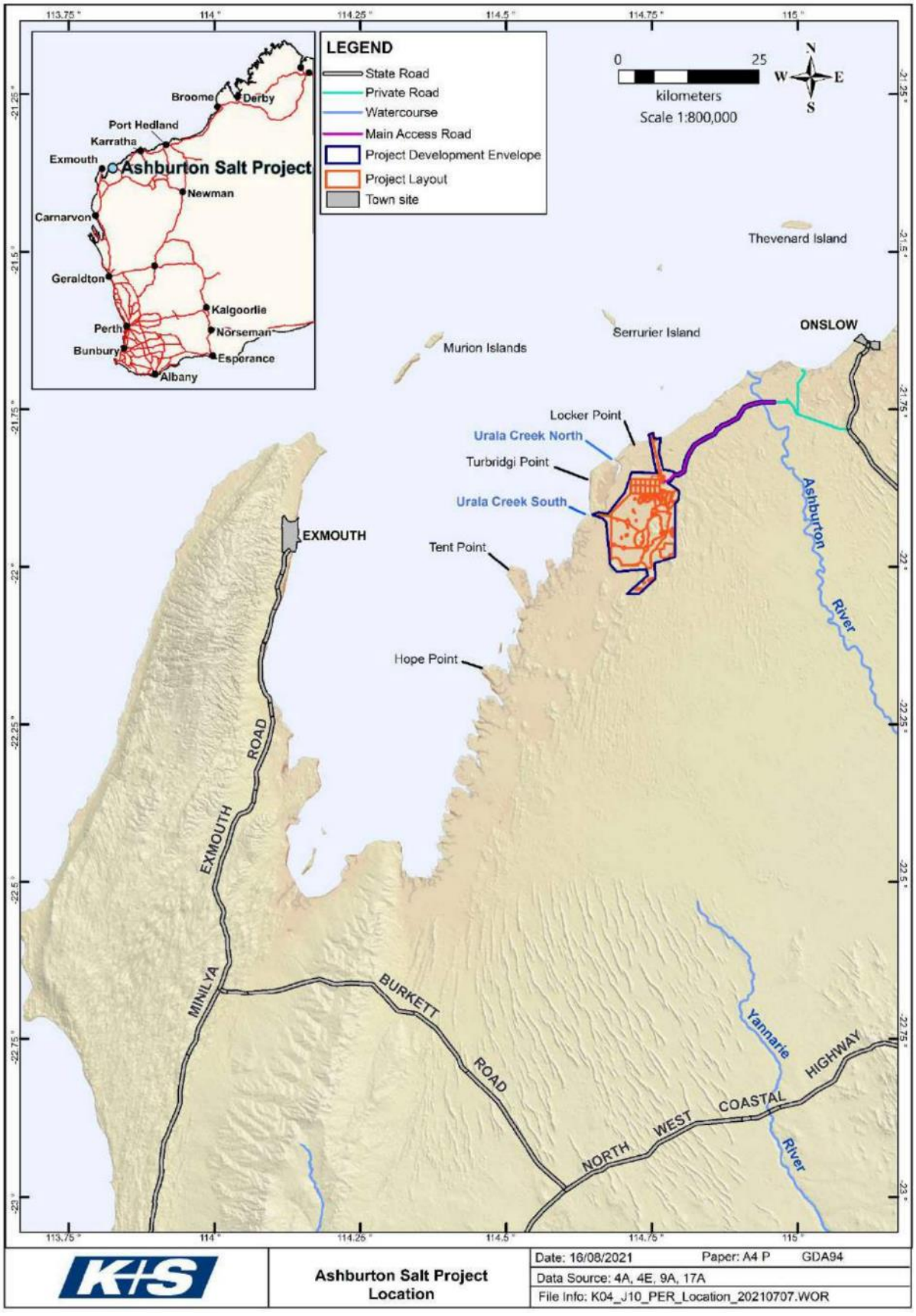


Figure 1 Regional location of the Proposal

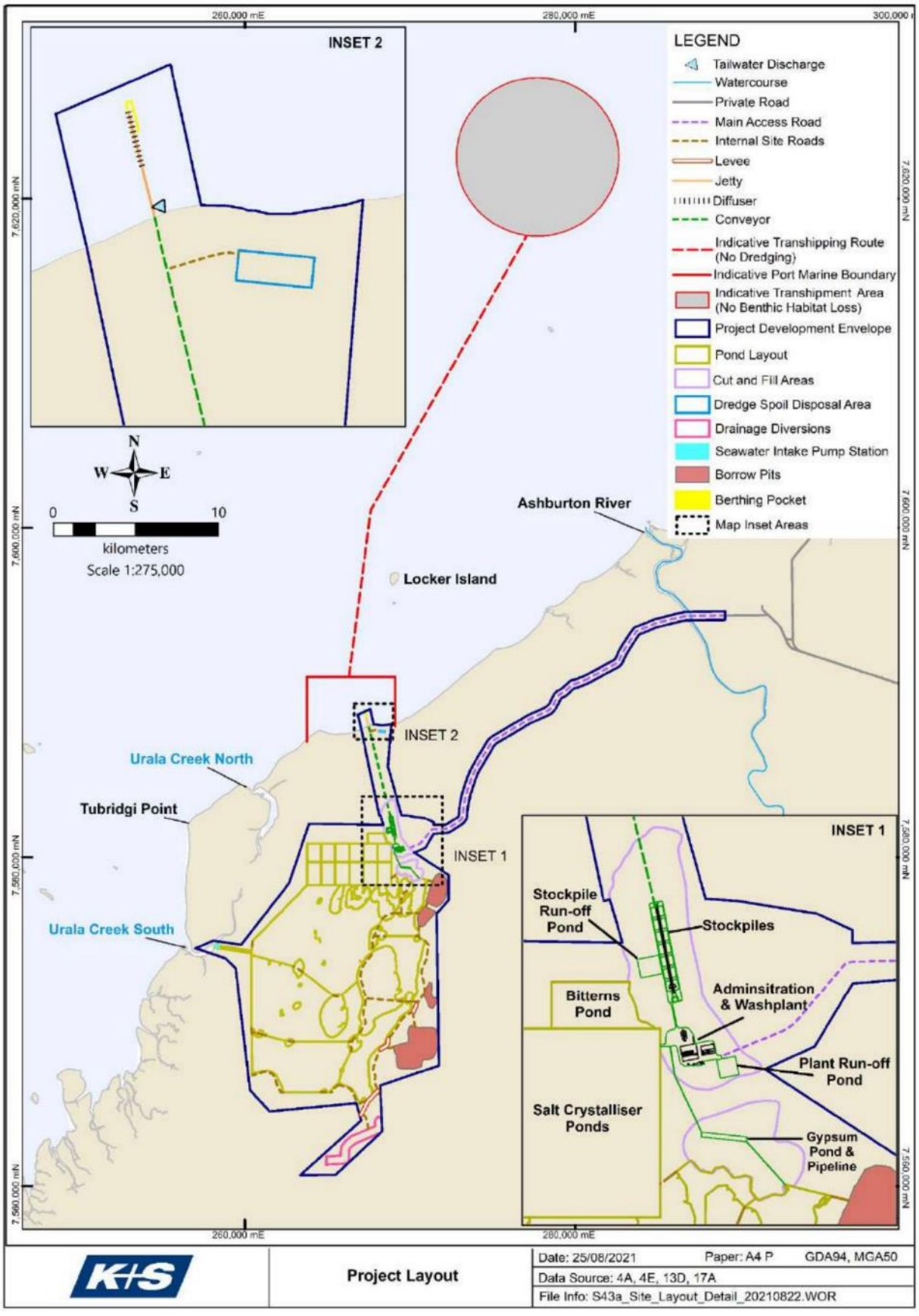


Figure 2 Proposed Development Envelopes and indicative layout

1.3. Scope of the Plan

The scope of the MEQMMP applies to the following operational activities of the Project:

1. Bitterns wastewater discharge, including the commissioning, validation and ongoing operational phases
2. Product handling and storage operations on land, in the nearshore berth facility and at offshore mooring area
3. Hydrocarbon handling and spill risk assessment and management within the marine environment.

This MEQMMP sets out a process for monitoring and reporting operational impacts against acceptable limits of ecological change during the lifecycle of the Project. Where results outside the limits of acceptable change are reported, a pre-determined risk-based management response is triggered to ensure the EVs and EQOs are not compromised. This MEQMMP has been prepared in accordance with the EPAs Technical Guidance – Protecting the Quality of WA's Marine Environment (EPA, 2016a), and details the specific process for continual revision and improvement of the MEQMMP any time the Project progresses, or at any time key processes alter and new risks are identified.

To ensure the objectives of the MEQMMP are achieved the following key processes have been defined:

1. Pre-Project Baseline Data Collection
    - Derive locally relevant EQC from baseline data to inform ongoing monitoring and management
2. Commissioning and Validation
    - Undertake further whole of effluent toxicity (WET) of the final bitterns during the commissioning phase to ensure the Species Protection Levels (SPL) within the outfall mixing zone and the designated Levels of Ecological Projection (LEP) are appropriate
    - Validate the accuracy of numerical modelling in predicting the extent of the mixing zone
    - Validate performance of the bitterns outfall diffuser during both commissioning and operational phases of the Proposal.
3. Ongoing MEQ Monitoring
    - Monitor and mitigate potential impacts to MEQ throughout the life of the Project.

2. Existing Environment

2.1. General Environment

2.1.1. Climate & Oceanography

The climate at the Project site is classified as hot, semi-arid with potentially significant rainfall occurring during late January through March and then May through July (K+S, 2021a). The dry season occurs from late August through to December. There is a tropical cyclone season that runs from the middle of December to April, with a peak occurring in the months of February and March. Climate data is collected at Onslow Airport, approximately 40 km north-east of the Project. Mean maximum daily temperatures are typically highest in January and February with 36.5°C, and lowest in July with 25.6 °C (BoM, 2022).

Winds are generally south or south-westerly for most of the year, with more south-westerly winds common during the summer months around the Exmouth Gulf region. During the cyclone season (mid-December to April), wind patterns are similar, though higher winds are typically blowing from westerly and north-westerly directions (K+S, 2021a).

Sea surface temperature around the project site varies from 20°C in August to a maximum of 30°C in March. Salinity levels measured in-situ at Locker Point between December 2018 and October 2020, ranged from 36.3 PSU to 41.6 PSU, with a median of 40 PSU (Water Technology, 2021a).

Wave energy in the area is typically relatively low, with typical directions of west to north-northeast and generally sheltered from swell wave energy from the south-west by the North West Cape. Swells can also be generated during cyclones or storms further away and these are more likely to come from the north and northeast (Water Technology, 2021a). Water movement is primarily driven by a combination of tidal and wind, in addition to the various currents influencing the area (Water Technology, 2021a). At the proposal site, tides are semidiurnal with a mean spring tidal range of approximately 0.89 m as measured at Exmouth and Onslow, with a general consistency of tidal height within Exmouth Gulf and along the coast.

2.1.2. Geomorphology

The Project area is located inshore on supratidal salt flats, adjacent to the northeast shore of Exmouth Gulf and the Onslow Coastal Tract, encompassing geomorphic features from both regional scale units. The area extends from a coastal shoreline comprised of either a tidal mangrove zone (i.e. fringing the northern more extent of Exmouth Gulf) or sandy beaches (i.e. that extend east from Tubridgi Point), across the salt flats of the Onslow Plain to where this plain abuts the terrestrial habitats of the Carnarvon Dunefield on the mainland (AECOM, 2022a).

2.1.3. Marine Water Quality

Nearshore waters within and around the project area are characterised by variable turbidity. Data was collected at Locker Point (near the proposed jetty and bitterns discharge) between December 2018 and October 2020, and at Urala Creek (near the proposed seawater intake), between December 2018 and February 2020 (K+S, 2021). Data was collected both in-situ and samples for NATA accredited laboratory analysis. Laboratory ranged from 0.6 Nephelometric Turbidity Units (NTU) to 8.3 NTU at Locker Point, and a smaller

range at Urala Creek with a minimum of 0.7 NTU and 6.7 NTU. Turbidity in-situ was found to be more variable within the sites, with Locker Point ranging from 0.29 to 13.4 NTU, and Urala Creek ranging from 0.12 to 14.3 NTU. Generally the region also experiences high variability in turbidity due to storm events and cyclones, which found median data within the Wheatstone project area increase to 77 NTU, in a site usually showing a median of 1 to 3 NTU (MScience, 2009).

As previously stated, salinity data has also been collected for the assessment of this proposal between December 2018 and October 2020 at Locker Point. In addition to this, Total Dissolved Solids (TDS) was also measured which is also a good indicator of salinity. During the monitoring period, salinity ranged between 36.3 PSU and 41.6 PSU, with a median of 40 PSU and 80th percentile of 40.7 PSU. TDS ranged between 35,621 and 40,155 mg/L, with a median of 38,755 mg/L and 80th percentile TDS of 39,456 mg/L. Water samples were also taken within the project area approximately once a month during the monitoring period, and laboratory testing of TDS was conducted by a NATA accredited laboratory. TDS was found to show similar results between the two methods, with the laboratory TDS ranging from 36,000 to 41,000 mg/L, a median of 39,000 mg/L and an 80th percentile of 41,000 mg/L (Water Technology, 2021a).

Dissolved metals in water were measured approximately once a month at Locker Point between December 2018 and February 2020. Most metals analysed were found to be below the recommended Environmental Quality Criteria (EQC) specified for the protection of North West Shelf ecosystems (99% species protection levels or all metals, except cobalt which is set at 95% species protection) (K+S, 2021). The Laboratory Practical Quantitation Level (PQL) of Aluminium was set at 0.01 mg/L by the laboratory used, which was above the low reliability screening level of 0.0005 mg/L. This was the lowest PQL that could be achieved without onerous additional validation work which was not considered necessary given the proposed bitterns discharge characteristics (K+S, 2021). Aluminium exceeded the EQC of 0.002 mg/L on two occasions. Zinc exceeded the ANZG (2018) EQC 99% species protection level of 0.007 mg/L on two occasions. The laboratory PQL for copper was set above the ANZG (2018) EQC 99% species protection level of 0.0003 mg/L, at 0.001 mg/L, and results exceeded the level of 0.0003 mg/L on two occasions. The laboratory was able to lower the PQL for further testing in 2021, and samples taken in February, March and April 2021 were all found to exceed the ANZG (2018) EQC 99% species protection level of 0.0003 mg/L, ranging between 0.0006 mg/L in February, and 0.0008 mg/L in April 2021. This indicates that copper may be naturally higher than the 99% species protection level within the project area.

2.1.4. Sediment Characteristics

Sediment sampling has been undertaken for the proposed dredging works to construct the jetty. Particle size analysis found surface sediments were fine to coarse sand, typically less than 0.63 mm (GHD 2021a; Water Technology 2021c). Metals and metalloids analysed in February 2020 were below the ISQG (low value) with the exception of arsenic in one sample, which was found to be in excess of the guideline value of 20mg/kg, with the sample being 23 mg/kg (GHD 2021a). Organic compounds were found to be below the laboratory limit of reporting for all analytes. Radionuclides were present in all samples analysed, but all below the ISQG (low value) for radionuclides.

ASS analysis found the following:

- pHLAB values presented limited variability between the samples submitted for analysis, with a population variance of 2.90 pH units. Of the samples submitted for pH screening the following were reported: maximum pHLAB of 9.2, minimum of 4.6 and average concentration of 8.0
- pHFOX values presented limited variability between the samples submitted for analysis, with a population variance of 0.33 pH units. Of the samples submitted for pH screening the following were reported: maximum pHFOX of 9.2, minimum of 7.7 and average concentration of 8.5
- The acid based accounting for the sediments indicated that net acidity (utilising chromium reducible sulfur method) ranged between 220 mol H+ /tonne and less than the laboratory limit of reporting
- Material analysed was dominated by potential acidity due to the sub-oxic and potentially anoxic conditions
- Suspension Peroxide Oxidation Combined Acidity ad Sulphur (SPOCAS) suite indicated slightly increased net acidity values likely due to the presence of organic sulfur forms within the sediment profile
- Acid Neutralising Capacity (ANC) ranged between 140 and 3400 mol H+ /tonne (utilising SPOCAS method) indicating a significant potential for neutralisation within sediments less than 2 mm (GHD, 2021a).

These results indicate that sediments contained relatively low net acidity in excess of the DER ASS criteria. Sediments (< 2 mm) also presented significant acid neutralising capacity (ANC). Whilst the effective ANC of the sediment is likely to be varied due to particle size and armouring within the natural environment, the material is considered most likely to be hyposulfidic (GHD 2021a). Neutralising material will be added to the dredged material as necessary to treat any ASS detected. Decant water will be retained for a suitable time to allow appropriate water quality standards to be met (confirmed by monitoring) prior to release to the marine environment. Solids will be tested to ensure appropriate environmental standards are met, then will be reclaimed and used in on-site embankment construction.

2.1.5. Benthic Communities & Habitat

A range of studies to assess impacts to benthic communities and habitats have been conducted for the Ashburton Project (K+S, 2021; AECOM, 2022a). The benthic habitat types which have been identified across the Ashburton Project area include:

- Soft sediment (potential seagrass), macroalgae dominated reef and macroalgae and sparse coral reef in the Subtidal zone
- Mangroves, transitional mudflats, algal mats, sandy beaches and tidal creeks in the Intertidal zone
- Salt flats and samphire in the Supratidal zone (note that the Supratidal zone is not mapped within the LAU boundaries as it is not considered part of the scope of EPA Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016a).

Three Local Assessment Units (LAUs) have been proposed in consultation with Department of Water and Environment Regulation (DWER) Marine Ecosystems Branch around the Project site as shown in Figure 3 (AECOM 2022a). The three LAUs include one nearshore/subtidal LAU, and two intertidal LAUs, named LAU North and LAU South. Justification for the boundaries for these are given in AECOM (2022a).

The intertidal LAUs were mapped using existing maps, recent high-resolution satellite imagery and ground-truthing fieldwork (AECOM 2022a). The habitat types within these areas were identified as:

- Mangroves
- High tidal mud flats
- Algal mats
- Salt flats
- Sandy beaches
- Sand bars and shoals at the mouth of tidal creeks.

The mangrove and algal mat habitats have been mapped and shown in Figure 3.

The subtidal LAU area was mapped by AECOM using towed video transect data, aerial imagery, LiDAR bathymetry data and Sonar transect data (Figure 4, AECOM 2022a). It was found that the LAU consisted of the following three habitat types:

- Soft sediment (potential seagrass habitat): the majority of the LAU was found to be unconsolidated sediment consisting of predominantly sand and silt. This area is viewed as potential seagrass habitat
- Macroalgae: found to occur nearshore on the reef pavement extending from the beach along the coast. There was found to be a mixed assemblage of *Sargussum* sp. (prominent), *Caulerpa* and *Halimeda*.
- Macroalgae and sparse coral: this habitat type occurred on the seaward edge of the reef pavement extending offshore along the coast, and another patchy area approximately 2 km offshore in the south western portion of the LAU. Along with the macroalgae species, scattered corals, sponges, hydroids and ascidians were also found to exist within this habitat.

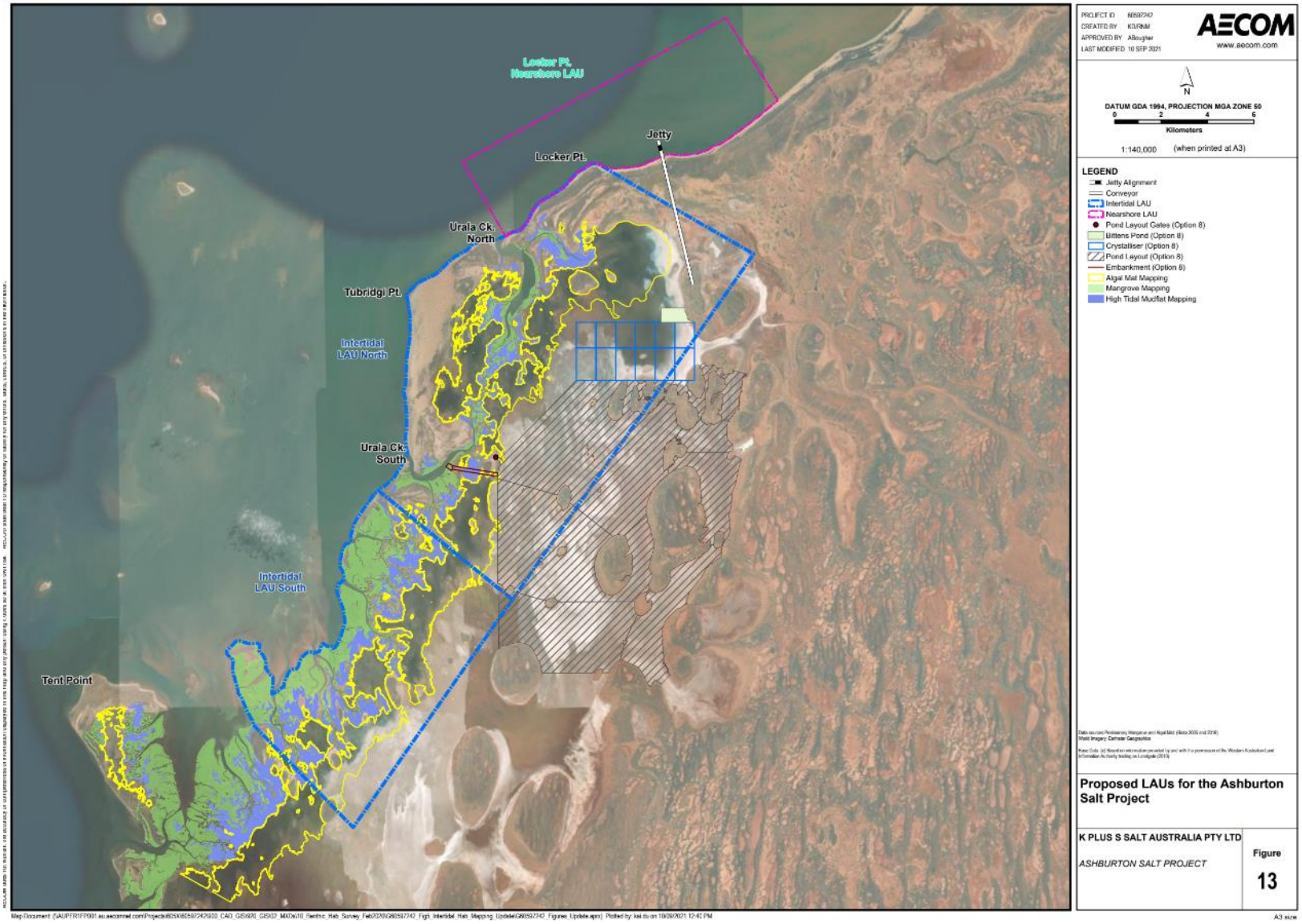


Figure 3 Proposed LAUs for the Ashburton Salt Project (AECOM 2022a)

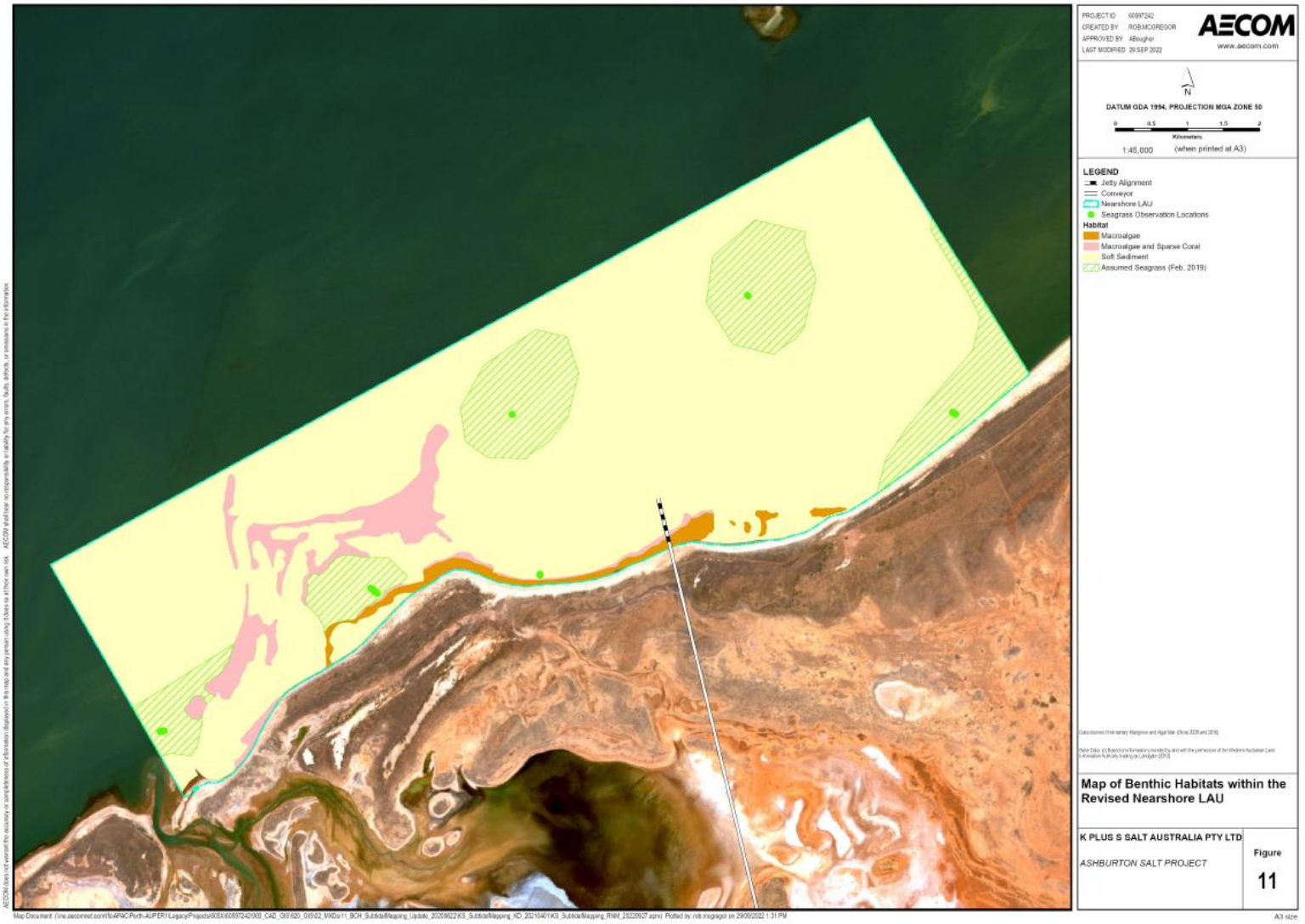


Figure 4 Subtidal BCH mapping (AECOM 2022a)

2.1.6. Marine Fauna

A marine fauna impact assessment was undertaken for the Project by AECOM (2022b) which collated desktop literature review and gap analysis information, and field survey data. Identification of 'key' species as those with the highest conservation value, which could be impacted by the Proposal ensures that the correct level of attention is paid to those at greatest potential risk. The key conservation significant species were identified based on their status and likelihood of occurrence in the Proposal area. Key species that were identified as 'likely to occur' within the project area are:

- Green sawfish
- Green guitarfish
- Bottlenose wedgefish
- Nervous shark
- Humpback whale
- Australian humpback dolphin
- Dugong
- Hawksbill turtle
- Flatback turtle
- Green turtle
- Loggerhead turtle

Ecological windows which construction activities should aim to avoid have been identified for these key species and presented in Table 3. Other management measures will also indirectly protect other, similar, species.

The Project footprint also intersects with a number of commercial fisheries boundaries. However, most are unlikely to be affected as the Project does not occur within the fishing target areas or due to size of the Project and the relative size of the fishery (K+S, 2021). Only two fisheries have been identified to be considered potentially impacted by the project. These are:

- Exmouth Gulf Prawn Fishery
- North Coast Prawn Fishery including Onslow Prawn Managed Fishery (OPMF)

The target species of the Exmouth Gulf Prawn Fishery have been identified as being impacted in the larval stage within the proposed Project seawater intake in Urala Creek South. The proportion of nursery area likely to be influenced by the Project has been modelled and predicted to be 0.39% of the total size of the Nursery area (Water Technology 2018). Therefore, it is unlikely to be a significant impact on the fishery. The OPMF occurs to the immediate north of the Project site and the Project is considered to have minimal impact on the fishery (K+S, 2021).

Table 3 Key Conservation Species' Ecological Windows* (AECOM 2022b)

Species	J	F	M	A	M	J	J	A	S	O	N	D	Data Source
Green sawfish													Morgan et al. (2017)
Giant guitarfish													
Bottlenose wedgefish													
Humpback whale – northern migration (Jurien Bay to Montebello)													CALM (2005); Environment Australia (2002), Jenner et al. (2001); McCauley and Jenner (2001)
Humpback whale – southern migration (Jurien Bay to Montebello)													McCauley and Jenner (2001)
Spotted bottlenose dolphin													
Australia humpback dolphin													
Dugong													
Hawksbill turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021a)
Flatback turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021b)
Green turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012)
Loggerhead turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021c)

* Dark Blue represents species likely to be present in the region, Light Blue represents peak period: presence of animals reliable and predictable each year

3. Rationale and Approach

3.1. Key Environmental Factors

The Project operations include multiple activities that, if left unmanaged, have the potential to impact natural MEQ of the area. These activities include both the release of bitterns wastewater, handling and storage of a high saline product and hydrocarbon use in vessels.

The Environmental Protection Authority (EPA) outlines a series of environmental principles, factors, and objectives in EPA (2018). The key environmental factor associated with this MEQMMP is Marine Environmental Quality (MEQ). The Environmental Values (EVs) and Environmental Quality Objectives (EQOs) relevant to the Project are summarised in Table 4.

The Western Australia (WA) EPA's environmental objective for the factor MEQ is '*To maintain the quality of water, sediment and biota so that environmental values are protected*' (EPA 2021a).'

The relevant policy and guidance considered in the assessment of the MEQ factor are:

- Statement of Environmental Principles, Factors and Objectives (EPA 2021a)
- Instructions on how to prepare an Environmental Review Document (EPA 2021b)
- Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016a), and
- Environmental Factor Guideline – Marine Environmental Quality (EPA 2016b).

Table 4 Key environmental factors, values, and objectives, relevant to the Ashburton Infrastructure Project

EPA Theme	EPA Factor	Environmental Values	Environmental Quality Objective	Pathway
Sea	Marine environmental quality	Ecosystem health	Maintenance of Ecosystem Integrity	The Project has the potential to modify water quality during the operational phase through processing and storage of seawater, and discharge of bitterns wastewater.
				The Project has the potential to modify water quality during the operational phase through operational activities associated with port operations
		Recreation and aesthetics	Maintenance of Aesthetic values	Impacts to social surroundings and values may occur due to changes to water quality during the discharge of bitterns during the operational phase.

Other environmental factors, being Benthic Communities and Habitat (BCH) and Marine Fauna, have the potential to be impacted through changes in water quality, but these factors are considered to be protected through maintenance of MEQ.

3.2. Environmental Quality Management Framework

The Environmental Quality Management Framework (EQMF) was developed to implement the National Water Quality Management Strategy Guidelines No. 4 and 7 (ANZG 2018). In WA the EQMF process has been utilised as a guide to implement water quality monitoring and management after being incorporated into the State Water Quality Management Strategy No.6 (SWQMS 2004). The EPA provides further guidance for the development and application of the EQMF as a consistent and standardised approach for measuring and reporting on MEQ across other areas of WA's marine environment (EPA 2016b). The EQMF incorporates the following:

- Identifying EVs
- Establishing EQOs and spatially defining LEPs that need to be maintained to ensure the associated EVs are protected
- Monitoring and managing to ensure the EQOs are achieved and/or maintained in the long-term in the areas they have been designated
- Establishing Environmental Quality Criteria (EQC), which are quantitative benchmarks against which monitoring results can be compared.

There are two levels of EQC:

- Environmental Quality Guidelines (EQGs) are quantitative, investigative guidelines which signify low risk of an environmental effect if they are met, and trigger further investigations if an exceedance occurs
- Environmental Quality Standards (EQSs) are management guidelines based on multiple lines of evidence, which if exceeded signify that the Environmental Quality Objective is not being met and that a management response is required. EQS are generally based on a level of acceptable change in a biological or ecological indicator.

The key structural elements of the EQMF are shown in Figure 5.

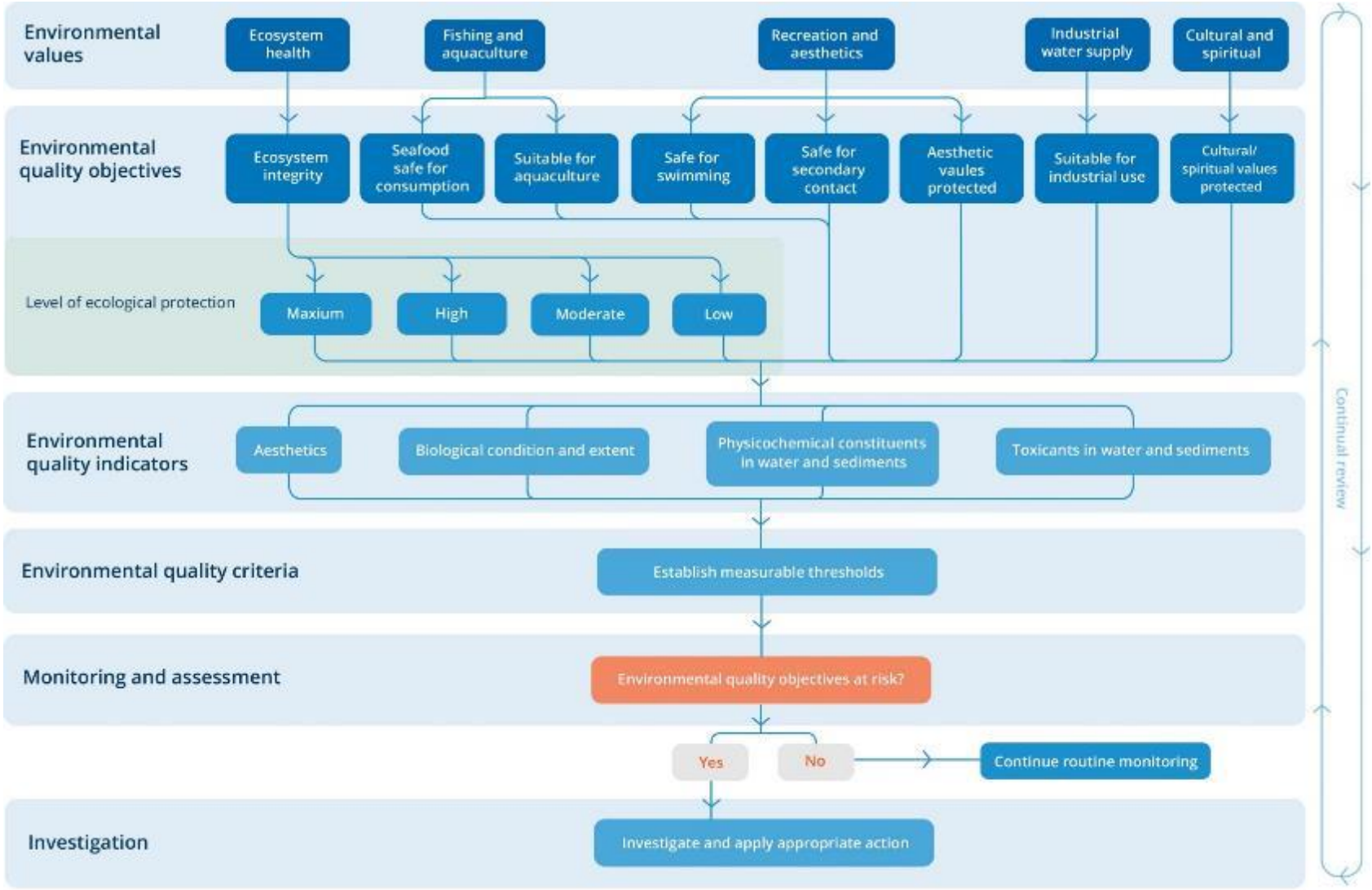


Figure 5 Environmental Quality Management Framework

3.3. Environmental Values and Environmental Quality Objectives

EVs are defined as "Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits" (ANZG 2018). EQOs are high level management objectives that describe what must be achieved to protect each EV (EPA 2016a).

The EVs and associated EQOs for the Pilbara marine environment are already well established in the Pilbara Coastal Waters Consultation Outcome (DoE 2006). Five EVs and eight corresponding EQOs apply to the area surrounding and including the Project. These EVs and corresponding EQOs are presented in Table 5.

Note that while the five EVs and eight EQOs are relevant to the Project, only EQOs No. 1, 4 and 6 require development of Environmental Quality Indicators (EQIs) under this plan. The remainder are not considered at risk from implementation of the Project if EQO1 is met. It is noted that there are no aquaculture facilities in the vicinity of the Project.

Table 5 Environmental Values and Environmental Quality Objectives applicable to the Ashburton Salt Project area

Environmental Values	Environmental Quality Objectives	Separate Environmental Quality Indicators required?
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low LEPs (Refer Section 3.3 below).	Yes
Fishing and Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption.	No (Protection of Ecosystem Health will protect this EQO)
	EQO3: Water quality is suitable for aquaculture purposes.	Not relevant to this Project
Recreation & Aesthetics	EQO4: Water quality is safe for primary contact recreation (e.g., swimming and diving).	Yes
	EQO5: Water quality is safe for secondary contact recreation (e.g., fishing and boating).	No (Protection of primary contact recreation EQO will protect this EQO)
	EQO6: Aesthetic values of the marine environment are protected.	Yes
Cultural & Spiritual	EQO7: Cultural and spiritual values of the marine environment are protected.	No (Protection of Ecosystem Health will protect this EQO)
Industrial Water Supply	EQO8: Water quality is suitable for industrial supply purposes.	No (Protection of Ecosystem Health will protect this EQO)

3.4. Levels of Ecological Protection

In accordance with EPA (2016b), the objective for 'Ecosystem Health' is spatially allocated into four LEPs: Maximum, High, Moderate and Low. Each LEP area is assigned an acceptable limit of change (EPA 2016b). The spatial distribution of the LEPs enables measurable EQOs to be allocated to areas in accordance with expectations for ecosystem health condition. For example, important areas for conservation are assigned a Maximum LEP and maintained within the limits of natural variation, whereas large changes from natural variation may be allowed in small areas assigned a Low LEP around a bitterns discharge (where EVs may not be protected).

LEP boundaries have been previously described for the waters in the Exmouth Gulf area within DoE (2006). The Project loading jetty and bitterns diffuser is to be located within an area given a High LEP (Figure 6**Error! Reference source not found.**) with only the seawater intake being in a Maximum LEP (Figure 8). These existing LEP boundaries were reviewed and updates are proposed in the context of the Project.

As described in Water Technology (2021b) the following EQGs have been proposed for salinity:

1. The High LEP salinity EQG was calculated as 1.6 PSU above background (being the 12 month rolling average of the difference between the rolling 80th percentile and rolling median of the 20 month background salinity dataset)
2. The Moderate LEP salinity EQG was calculated as 2.2 PSU above background (being the 12 month rolling average of the difference between the rolling 95th percentile and rolling median of the 20 month background salinity dataset).

The following ecological protection areas have been identified based on EPA (2016):

1. The existing area is already classified as a High Ecological Protection Area (HEPA) from Locker Point until approximately 1 km south-west of the Ashburton River mouth (about 20 km of coastal line) (DoE 2006)
2. A Moderate Ecological Protection Area (MEPA) is proposed in the region where the median salinity level of the modelled bitterns discharge plume is within the 95th percentile of natural background salinity. The outer boundary of the MEPA (where the MEPA ends and HEPA begins) represents the location where the median salinity level of the modelled discharge plume is within the High LEP salinity EQG (1.6 PSU above background)
3. A Low Ecological Protection Area (LEPA) is proposed around the diffuser itself with no EQG applied. The outer boundary of the LEPA (where the LEPA ends and MEPA begins) represents the location where the median salinity level of the modelled bitterns discharge plume is within the Moderate LEP salinity EQG (2.2 PSU above background).

ANZG (2018) provides default guideline values for assessing a range of toxicants (including metals) in marine waters. The use of these ANZG default guideline levels is recommended by the WA EPA (2016) which states that:

- For a High LEP: 99% species protection levels are adopted with the exception of cobalt where 95% species protection levels are recommended (EPA 2016).
- For a Moderate LEP: 90% species protection levels are adopted (EPA 2016).

All metals assessed are predicted to be diluted to achieve a HEPA which are 60 m or less from the diffuser. This is within the guideline size recommended by EPA (2016) for a LEPA (70 m from the diffuser). The predicted impact is expected, given the diluted bitterns is a hypersaline solution consisting mainly of salts, whereas metals are relatively minor constituents of the bitterns. Therefore, the salinity dilution required is orders of magnitude higher than the requirement for metals to achieve a High Level of Ecological Protection. As a result, the optimised diffuser which has been designed to dilute the bitterns discharge 100:1 in the nearfield (less than 10 m from the diffuser) will by default achieve the required metals dilutions within a short distance from the diffuser.

Figure 6 identifies the proposed LEP boundaries in context of the existing HEPA and mapped subtidal BCH in the Project area.

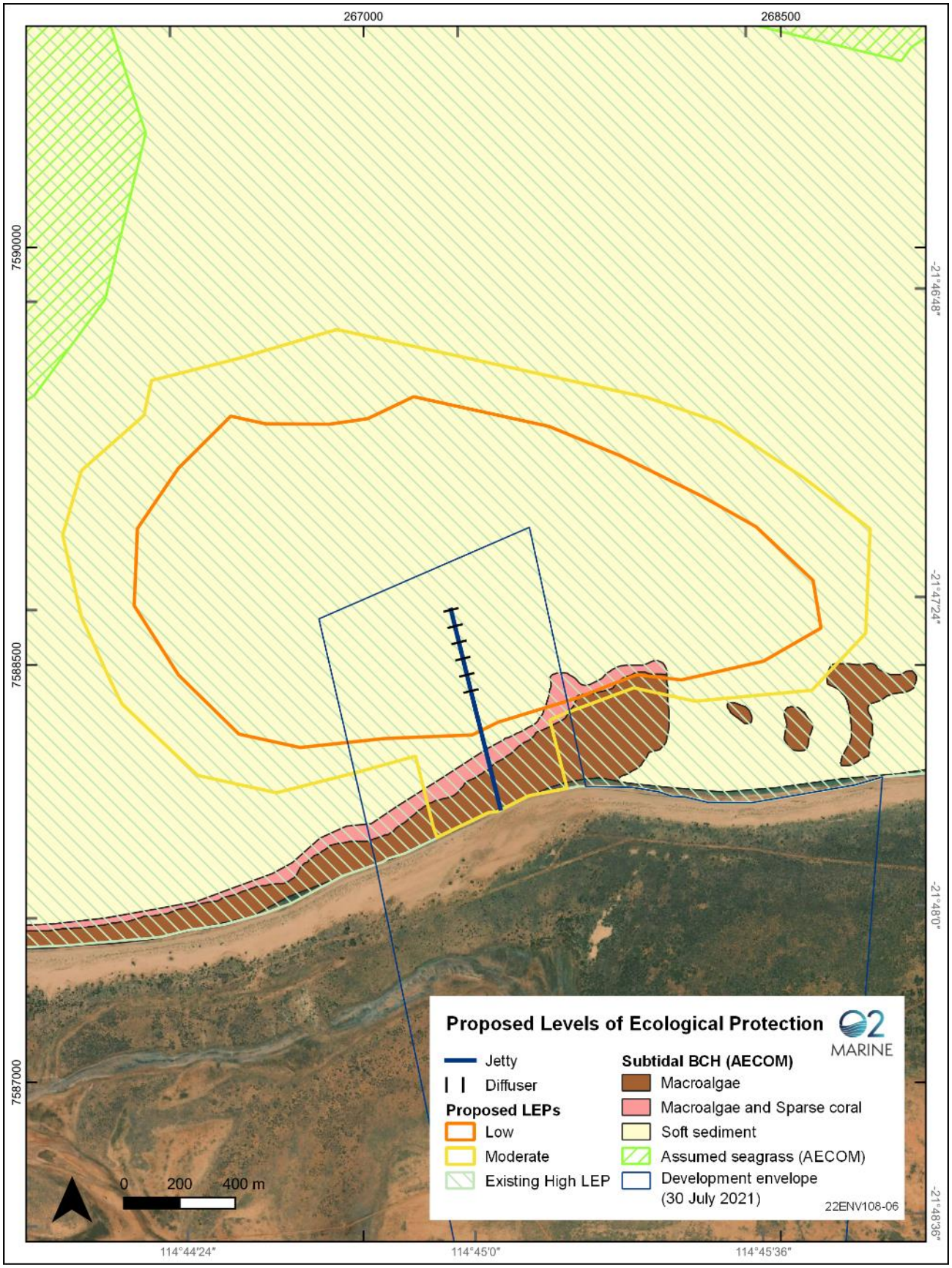


Figure 6 Proposed Levels of Ecological Protection in relation to mapped subtidal BCH.

4. Key Operational Pressures on the Environment

4.1. Bitterns Wastewater Discharge

The production process is predicted to produce a high-salinity bittern (approximately 300 PSU) that will be diluted with seawater at a ratio of 1:1 and discharged into the marine environment through a diffuser extending from the end of the jetty (Figure 6Error! Reference source not found.). In the absence of a bitterns product at the early EIA stage of the Project, an appropriate surrogate was used for WET testing, to represent the predicted toxicity of the discharge bitterns. WET testing was performed for approval of the Mardie Project, another solar salt proposal in the Pilbara, and utilised a surrogate bittern collected from the Onslow Salt processing facility (Onslow, Western Australia). Details of this WET testing, including the chronic tests undertaken on locally relevant species are included in O2 Marine (2019). Based on these results, it was determined that the following dilutions of the waste bitterns would need to be achieved in order to meet the required SPL for each of the designated LEPs:

- 90% SPL requires 270 dilutions (LEPA/MEPA Boundary)
- 99% SPL requires 420 dilutions (MEPA/HEPA Boundary).

Prior to commencing full discharge operations, a diffuser commissioning phase will occur to allow initial validation of the outfall modelling and make final adjustments to the diffuser configuration (e.g. port spacing, port angle, etc.) and discharge operations (e.g. discharge rate, discharge velocity, pre-dilution rate, etc.) to ensure that the required number of dilutions are met at the LEP boundaries specified above. Key elements of the preliminary diffuser design and configuration are provided in Table 6.

From the bitterns dilution modelling undertaken by Water Technology (2021a) and by applying the species protection levels derived from the WET assessment (Figure 6), the predicted annual average bitterns discharge LEP areas comprise of:

- A Low Environmental Protection Area (LEPA) of less than 2,400 m in an along shore direction and 1,200 m in an offshore direction
- A Moderate Environmental Protection Area (MEPA) was less than 2,900 m in an alongshore direction and 1,700 m in an offshore direction.

Table 6 Indicative parameters for the Ashburton Salt Project outfall

Parameter / Feature	Value
Diffuser location	~400 m along the 700 m jetty , 2.3 m below Low Astronomical Tide (LAT)
Orientation	North-Northwest to south-southeast
Length of diffuser (m)	400 m
Number of nozzles	350
Discharge velocity (m/s)	6
Diffuser depth (m below MSL)	5 m

Parameter / Feature	Value
Discharge regime	Bitterns flow will range from about 0.14 m^3/s in June to about 0.98 m^3/sin November (highest evaporation rate leading to highest salt and wastewater production)
Bitterns discharge salinity – undiluted (ppt)	287.1
Pre-dilution (with 35.1 ppt)	1:1
Estimated outfall salinity	174.5
Whole Effluent Toxicity Results	99% SPL requires 420 dilutions – target bitterns concentration 0.24%
	90% SPL requires 270 dilutions – target bitterns concentration 0.38%

4.2. Port Operations

The Project includes the export of bulk salt. The salt will be loaded onto a transhipper barge using typical conveyors and ship-loading infrastructure, the barge will then travel offshore and re-load the salt onto an ocean-going vessel anchored approximately 14 nautical miles (nm) offshore.

Some product spills may occur during the loading of vessels, however these volumes will be relatively low and intermittent. Maintenance operations along the conveyor system will be required to remove built up product over time. This activity results in a low risk of hypersaline runoff water entering the receiving environment.

Vessel operations result in risks to MEQ through hydrocarbon spills (bunkering and other vessel chemicals), antifoulant contamination form the hull of vessels, and vessel movements, which are likely to continually mobilise and redistribute fine sediments in the vicinity of the berth pocket. Specific management in relation to bunkering procedures, chemical storage and vessel movements are included as part of this MEQMMP.

4.3. Product Storage and Processing Facilities

A spill or leak of bitterns from the ponds or pipelines could result in impacts to MEQ within the receiving environment. To help mitigate this risk, pipelines will utilise industry-standard materials to minimise the risk of leaks, regular monitoring and inspection of facilities and equipment will be implemented to further reduce this risk. Ponds have been designed with adequate freeboard and overflow features to minimise the risk of unplanned overflows and wall.

4.4. Pressure-Response Pathways

The operational activities and associated potential impact pathways for the Project are summarised in Table 7.

Table 7 Operational Activities and Potential Impact Pathways.

Facilities	Operational Activities	Potential Environmental Impact Pathway	EQO (EV) at Risk
Bitterns Discharge Operations	Discharge of bitterns to the marine environment.	Localised impact to water/sediment quality due to changed water quality conditions from the bitterns outfall. Risks to water and sediment quality are primarily associated with the diffuser not operating as expected or modelling predictions being incorrect.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
Port Operations	Vessel bunkering operations.	Contamination of water/sediment/biota resulting from a chemical/hydrocarbon spill/leak.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
	Product loading operations.	Impact to water and sediment quality as a result of a product spill.	EQO1 (Low/Moderate LEP) (Ecosystem Health)
	General vessel and barge operations	Contamination of water/sediment/biota resulting from vessel antifoulant.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
		Continual re-suspension of fine sediments resulting from vessel and barge movements may impact on BCH in the immediate vicinity.	EQO1 (Low/Moderate LEP) (Ecosystem Health)
Product Storage and Processing	Storage and handling of hydrocarbons and chemicals.	Contamination of water/sediment/biota resulting from a chemical/hydrocarbon spill/leak.	EQO1 (Maximum LEP) (Ecosystem Health)
	Product storage and processing	Direct impacts to water/sediment/biota resulting from leakage or failure of a pond bund wall/transfer pipes.	EQO1 (Low/Moderate LEP) (Ecosystem Health)

4.5. Environmental Quality Indicators

EQIs are measurable parameters selected to monitor changes in each EQO. The EQIs for the Project MEQMMP are summarised in Table 8. The adopted approach to derive preliminary EQGs is outlined within Figure 7.

Table 8 Environmental Quality Indicators for the Ashburton Salt Project

Environmental Quality Indicators	Environmental Quality Criteria					
	Environmental Quality Guidelines					Environmental Quality Standards
	Constituents[1]	Low LEP	Moderate LEP	High LEP	Maximum LEP	
Physicochemical Constituents in Water	Salinity[2]	No EQG Apply	95th percentile of natural background salinity concentration is achieved	80th percentile of natural background salinity concentration is achieved	No detectable change from natural background levels for Physicochemical parameters or toxicants within water and sediments	< No loss or decline within BCH communities outside of acceptable levels of change for MEPA (i.e., 95th percentile of natural background) and no change from natural within HEPA < No loss or decline within animal communities outside of acceptable levels of change for MEPA (i.e., 95th percentile of natural background) and no change from natural within HEPA < Salinity concentrations below the maximum calculated from WET testing and bitterns sampling for each LEP boundary
	Dissolved oxygen[2]		5th percentile of natural background DO concentration is achieved	80th percentile of natural background DO concentration is achieved		
	pH		5th or 95th percentile of natural background pH conditions are achieved	20th or 80th percentile of natural background pH conditions are achieved		
	Temperature		5th or 95th percentile of natural background temperatures are achieved	20th or 80th percentile of natural background temperatures are achieved		
	Dissolved major anions and cations Ionic balance		5th or 95th percentile of natural background ionic balance conditions are achieved	20th or 80th percentile of natural background ionic balance conditions are achieved		
	Total Alkalinity as CaCO3 Total Hardness as CaCO3		5th or 95th percentile of natural background conditions are achieved	20th or 80th percentile of natural background conditions are achieved		
Toxicants in Water[3]	Metals Hydrocarbons Chloride Fluoride	80% species protection trigger values for potentially bioaccumulating/ bioconcentrating chemicals	90% species protection trigger values	99% species protection trigger values[4]		< No loss or decline within BCH communities outside of acceptable levels of change for LEP

Environmental Quality Indicators	Environmental Quality Criteria					
		Environmental Quality Guidelines				Environmental Quality Standards
	Constituents[1]	Low LEP	Moderate LEP	High LEP	Maximum LEP	
		The required number of dilutions as determined through WET testing is achieved at LEP boundaries				(no change from natural within HEPA)
Toxicants in Sediment	Metals Antifoulants Hydrocarbons	Interim Sediment Quality Guideline (ISQG)-low trigger values but only for potentially bioaccumulating/ bioconcentrating chemicals	ISQG-low trigger values			< No loss or decline within animal communities outside of acceptable levels of change for LEP (no change from natural within HEPA) < 80th percentile of tissue concentrations in filter or deposit feeder at suitable reference site (HEPA) < Selected toxicant concentrations below the maximum calculated from WET testing and bitterns sampling for each LEP boundary

[1]: This list of consituents for EQGs is considered preliminary based upon identified potential risks. These will be revised at the completion of the MEQ Validation Phase (Refer Section 5.5.4)

[2]: EQGs will apply for surface and bottom waters

[3]:Where no guidelines trigger values are available, or the toxicants are naturally occuring at high levels the EQG will be derived from the 95th percentile of natural background concentrations and applied within the HEPA only.

[4]: Except cobalt where the 95% species protection trigger value applies

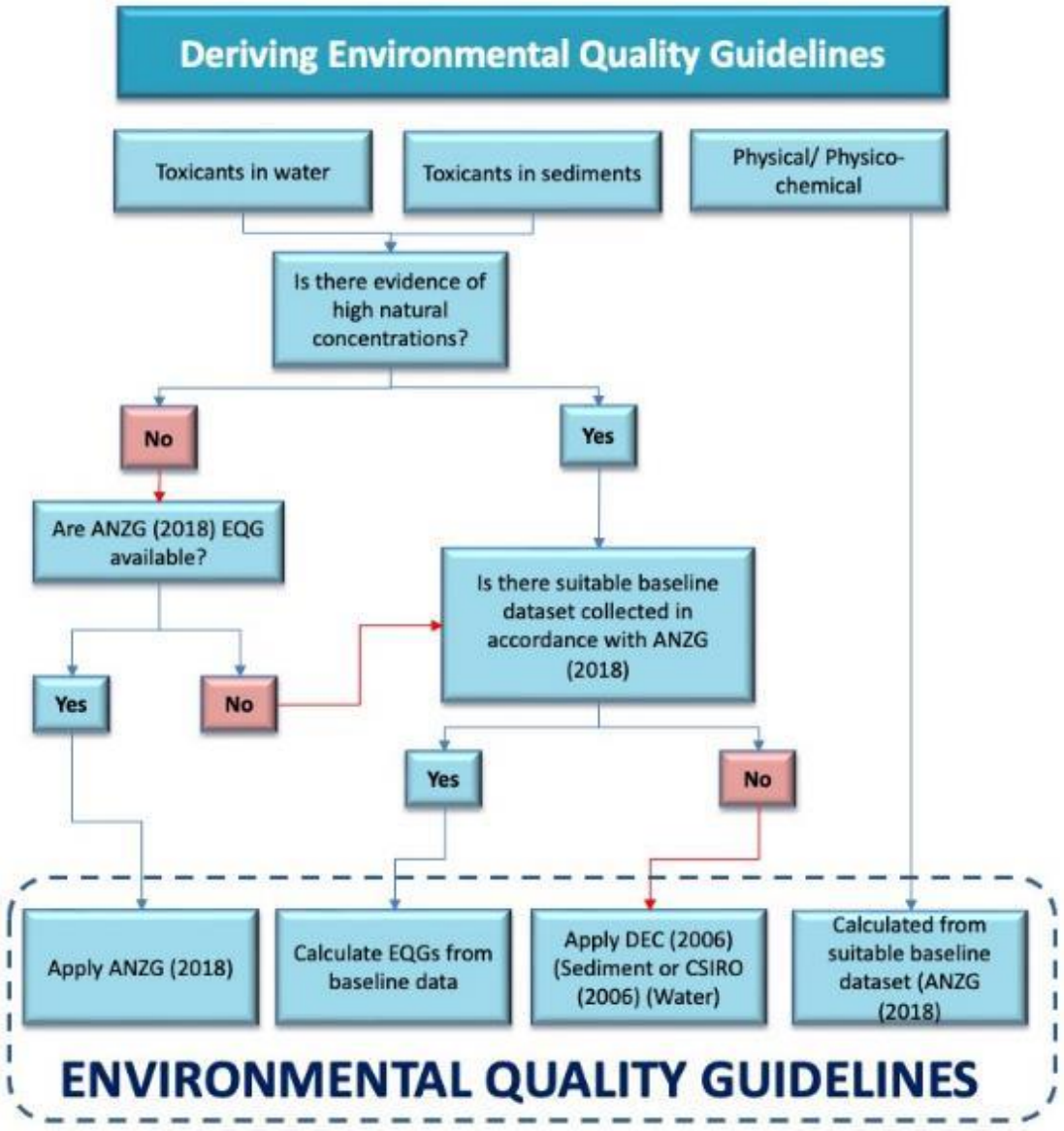


Figure 7 Method to Derive Preliminary Environmental Quality Criteria.

5. Risk assessment

5.1. Product and bitterns spillage risk

The Project includes the export of bulk salt. The salt will be loaded onto a transhipper barge using typical conveyors and ship-loading infrastructure, then the barge will travel offshore and transfer the products onto an ocean-going vessel anchored offshore.

During construction and operations there is the potential for accidental spills or inappropriate waste disposal to occur that may cause contamination of marine waters. Potential contaminants could include salt product, bitterns, hydrocarbons, dredge spoil/tailwater and general site wastes. Throughout the salt production process, no chemicals will be added at any stage of the process avoiding the spillage of chemical additives. Some product spills may occur during the loading of the transhipper vessels, however these volumes will be relatively low and intermittent, and will, overall, be managed in accordance with a Part V EP Act licence administered by DWER. With appropriate mitigation these impacts should not occur, therefore they are considered low risk. Spills and contamination will be prevented and mitigated through appropriate planning and management measures.

Prior to discharge, the bitterns flowing out of the crystalliser ponds will flow into a bitterns dilution pond. Seawater will be pumped into the bitterns dilution pond to dilute the bitterns to approximately a 1:1 ratio. In the event of an unlikely bitterns spillage, this mixing with seawater will reduce density to the level where further mixing by currents and waves will rapidly breakdown any spilled bitterns so that no permanent or long-term pools of denser liquid form on the seafloor.

Mitigation measures for managing the risk of product or bitterns spillage is provided in Section 6.5.

5.2. Hydrocarbons spillage risk

The occurrence of a hydrocarbon spill associated with the project construction or operation is considered highly unlikely, though is considered here for completeness. Potential sources of hydrocarbon spills include:

- Vessel collision or grounding resulting in vessel damage and breach of fuel tanks.
- Equipment failure resulting in unplanned release of fuel from a vessel or construction equipment.
- Failure to properly contain an onshore spill resulting in runoff into the marine environment.
- Failure of stormwater control and / or treatment systems resulting in contaminated runoff entering
- the marine environment.

It is noted that no bunkering or vessel refuelling will take place at the project location during construction or operation. While the likelihood of occurrence ins very low, any such release of hydrocarbons from these sources may result in the release of varying volumes and / or types of hydrocarbons.

Potential impacts associated with hydrocarbon release will depend on:

- The location of the spill in relation to sensitive receptors
- The volume and type of material released
- The environmental conditions at the time of the spill (i.e. current direction)

- Whether the material reaches the shoreline or is contained offshore

The spill of hydrocarbons and subsequent contact with subtidal habitats may be mitigated by the typically buoyant nature of such hydrocarbons. A buoyant plume is less likely to come into prolonged contact with benthic habitats in deeper waters. Where a spill occurs in, or is carried into, shallower waters, greater impacts would be expected. Shallow subtidal reefs and sandy beaches are particularly susceptible to hydrocarbon spills. Loss of macroalgae and sparse hard coral habitats may occur and areas of bare sediment and / or potential seagrass habitat may be impacted.

Should a spill occur in, or be carried into Urala Creek, there is a risk of impacts to both coral and seagrass beds in the mouth of Urala Creek, and mudflat, samphire and mangrove habitats further up the creek. The nature of this environment is such that the spill may be dispersed across mudflats, where containment and removal can be difficult. Depending on the volume and type of material spilled, the impacts may result in reduced health or mortality of mangrove and samphire vegetation and impacts to mudflat environments.

Potential impacts from spills to marine fauna may include:

- potential oiling of fauna (particularly seabirds) leading to injury of mortality
- loss or disturbance to critical habitat to marine fauna
- toxic effects to marine fauna.

Fish, marine mammals, marine reptiles and seabirds that come into contact with marine diesel may be directly affected. A diesel spill may also result in the localised mortality of planktonic organisms as they are unable to move away from affected areas. Within this area there is potential for fish, marine mammals, marine reptiles and seabirds to be affected by acute toxicity of diesel, however given the localised nature of a single spill trajectory and the fact that the majority of species are highly mobile, avoidance behaviour would be likely and high levels of mortality of fish and other species is not predicted.

Hydrocarbon spills are considered highly unlikely after mitigation measures are applied and it is therefore anticipated that the outcome will be no impacts to BCH or marine fauna resulting from hydrocarbon spills.
Monitoring and management programs

Mitigation measures for managing the risk of hydrocarbon spillage is provided in Section 6.6.

5.3. Summary of Monitoring and Management Programs

To ensure that EVs and EQOs defined for the Project are not compromised through operational activities, comprehensive monitoring and management programs have been proposed. A description and rational of these programs as they relate to potential MEQ impacts are presented in Table 9.

Table 9 Description and rational of the Marine Environmental Monitoring and Management Programs.

Element	Sub-Elements	Rationale	Management Strategy
Baseline Monitoring	Water Quality Monitoring Sediment Monitoring Benthic Infauna	To collect sufficient spatial and temporal data with a high level of replication from which site specific EQGs and EQS will be derived. Potential Project impacts have been identified to water and sediment quality, so monitoring has been designed in accordance with ANZG (2018) protocols for monitoring and assessment of these values.	Section 5.4

	Physical Observation		
Bitterns Discharge Commissioning and Validation	Bitterns Discharge Quality Bitterns Discharge Flowrate	To implement a monitoring and management program for bitterns outfall diffuser commissioning that meets MEQ expectations. This program targets the actual water quality being discharged to ensure that the design specifications are being achieved. If water quality of the discharge is achieved, then it is assumed through bitterns outfall modeling that the EQC within each LEP will be achieved (Note: the below program will validate this assumption)	Section 5.5
	Whole Effluent Toxicity Testing	To identify the actual toxicity of the bitterns discharge on local native species. These results will be used with other monitoring results to validate modelled impact predictions and verify the LEPs and EQCs.	Section 5.5.3
	Model and EQC Validation	To provide an assessment of whether the defined EQCs are being met at their respective LEPs and determine if the discharged bitterns conform with WET testing and modelled predictions and required dilutions are being achieved at the LEPA/MEPA and MEPA/HEPA boundaries during routine operations. These results will be used with other monitoring results to validate modelled impact predictions and verify the LEPs and EQCs	
Routine Operational Performance Assessment	Bitterns Diffuser Outfall Water Quality	To ensure that design specifications for bitterns discharge constituents, as defined by modelling and WET testing, are being achieved through the lifecycle of the Project.	Section 5.6
	Ongoing Marine Environmental Quality	To verify that impacts from operational activities associated with the Project, such as bitterns release, vessel operations, hydrocarbon storage and product storage and handling do not impact MEQ outside the limits of acceptable ecological change associated with the defined LEPs.	

5.4. Baseline Monitoring Program

5.4.1. Rationale

To determine impacts upon MEQ from the Project a comprehensive set of EQCs need to be defined that are specific to the local area where the bitterns will be discharged. The purpose of the baseline monitoring program is to collect data from the local marine environment with which to derive site specific EQCs for which actual project impacts can be measured against during commissioning and ongoing routine operations. This program is typically comprised of the following sub-monitoring elements:

- Physical observations
- Marine water quality profiling
- Marine water quality sampling
- Sediment sampling
- Benthic infauna sampling.

The baseline monitoring program will provide sufficient spatial and temporal data with a high level of replication from which site specific EQGs and EQS will be derived in accordance with ANZG (2018). Site specific EQGs and EQS will be used to define marine environmental performance during both the commissioning and routine operational phases of the Project lifecycle. In accordance with ANZG (2018), a two-year baseline monitoring period will provide a suitable data set for the intended purpose[1].

The baseline monitoring period will allow the fine tuning of sampling methodology to ensure the described practices are effective when applied during routine monitoring. Any lessons learnt, or alterations to the defined methodologies will be included into a revised version of this MEQMMP.

An overview of the baseline monitoring program is detailed below in Table 10.

[1] It is noted that a 14-month water quality baseline data collection period, and sediment quality investigations have already been implemented in September 2017 and between December 2018 and February 2020 specifically for the Ashburton Salt Project. These studies included monitoring sites either at the proposed diffuser location (sediment) or within a representative location of the proposed diffuser location (water quality). Further information is provided in Section 5.4.

Table 10 Baseline Monitoring Program Overview.

Element	Sub-Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
Baseline Monitoring	Water Quality Monitoring	Physico-chemical water column profiling	Electrical conductivity Salinity Temperature pH Dissolved oxygen Turbidity	Monthly	2 years*	3	NA
		Water sampling	Hydrocarbons Ionic balance Metals and metalloids	Monthly	2 years*	3	1
	Sediment Quality Monitoring	Sediment sampling	Particle size distribution Total organic carbon and moisture Metals and metalloids Hydrocarbons	Once only**	NA	12	1 (minimum)
	Benthic infauna	Sediment grab sample	Lowest taxonomic level	Annual	2 years*	7	3
	Aesthetic Observation	Physical observations	Nuisance organisms Large-scale deaths Oil/Film Natural reflectance Objectionable odour Floating debris, rubbish, surface slicks	Monthly	2 years*	3	NA

** Includes 14 months of baseline data already collected (refer Section 5.4.3)*

*** Baseline sediment quality sampling has been completed in 2017 and 2019/2020 (refer Section 5.4.3).*

5.4.2. Environmental Quality Criteria

The purpose of the baseline data collection phase is to collect data from which to derive site specific EQC, as such, there are site specific EQGs or EQSs for assessment of data. At the completion of this phase, EQC will be calculated which will apply to the MEQ monitoring programs outlined within Section 5.5 and Section 5.6.

5.4.3. Sampling Design

To capture seasonal trends, and to compare with the existing water quality baseline period, monthly water quality sampling and profiling are proposed for an additional 10-month period. Sediment quality assessments was undertaken in between October 2019 and March 2020, and therefore no further sediment quality studies are proposed. A benthic infauna study will be required to analyse temporal variation.

The existing water and sediment quality investigations for the Project were summarised in Section 2 and detailed in the technical documents listed below.

- Water Technology (2021) Marine, Coastal and Surface Water Data Collection report. Report prepared for K+S Salt Australia Pty Ltd
- GHD (2021) Acid Sulfate Soil and Sediment Study. Report prepared for K+S Salt Australia Pty Ltd.

Additional baseline water quality and benthic infauna data will be collected in accordance with Table 11.

Table 11 Additional Water Quality Monitoring Proposed for the Baseline data collection period.

Monitoring Event	Frequency	Additional Period	No. of Sampling Rounds*	No. of Sites	No. of Samples/Readings Collected*
Physico-chemical Water Quality Profiling	Monthly	1 year	10	3	30
Water Sampling	Monthly	1 year	10	3	30
Physical Observation	Monthly	1 year	10	3	30
Benthic Infauna	One-off sampling event			7	21

Table 12 presents the monitoring/sampling sites for the baseline monitoring program. Samples locations for the baseline water quality and the benthic infauna assessment are shown in Figure 8.

Table 12 Baseline Water Quality and Benthic Infauna Monitoring Program Overview

Site Name	Site Description	Proposed Level of Ecological Protection	Easting	Northing	Routine Sampling Tasks			
					Physical Observations	Physico-chemical Water Column Profiling	Water Sample Collection	Benthic infauna
Locker Point	14 months of existing baseline water quality is available for this site. It is considered representative of local waters adjacent to the proposed diffuser.	Low	267100	7588600	X	X	X	
Fly Island	14 months of existing baseline water quality is available for this site. This site is not expected to be impacted by operational activities and represents a reference site.	High	248331	248331	X	X	X	
UCS Nearshore	This site is located adjacent to the seawater intake within Urala Creek South and allows assessment of potential impacts related to this activity.	High	259517	7585289	X	X	X	
IG1 – IG6	Infauna Grab (IG) sites have been selected to represent baseline conditions at the LEPA/MEPA Boundary.	Moderate	TBC	TBC	X			X

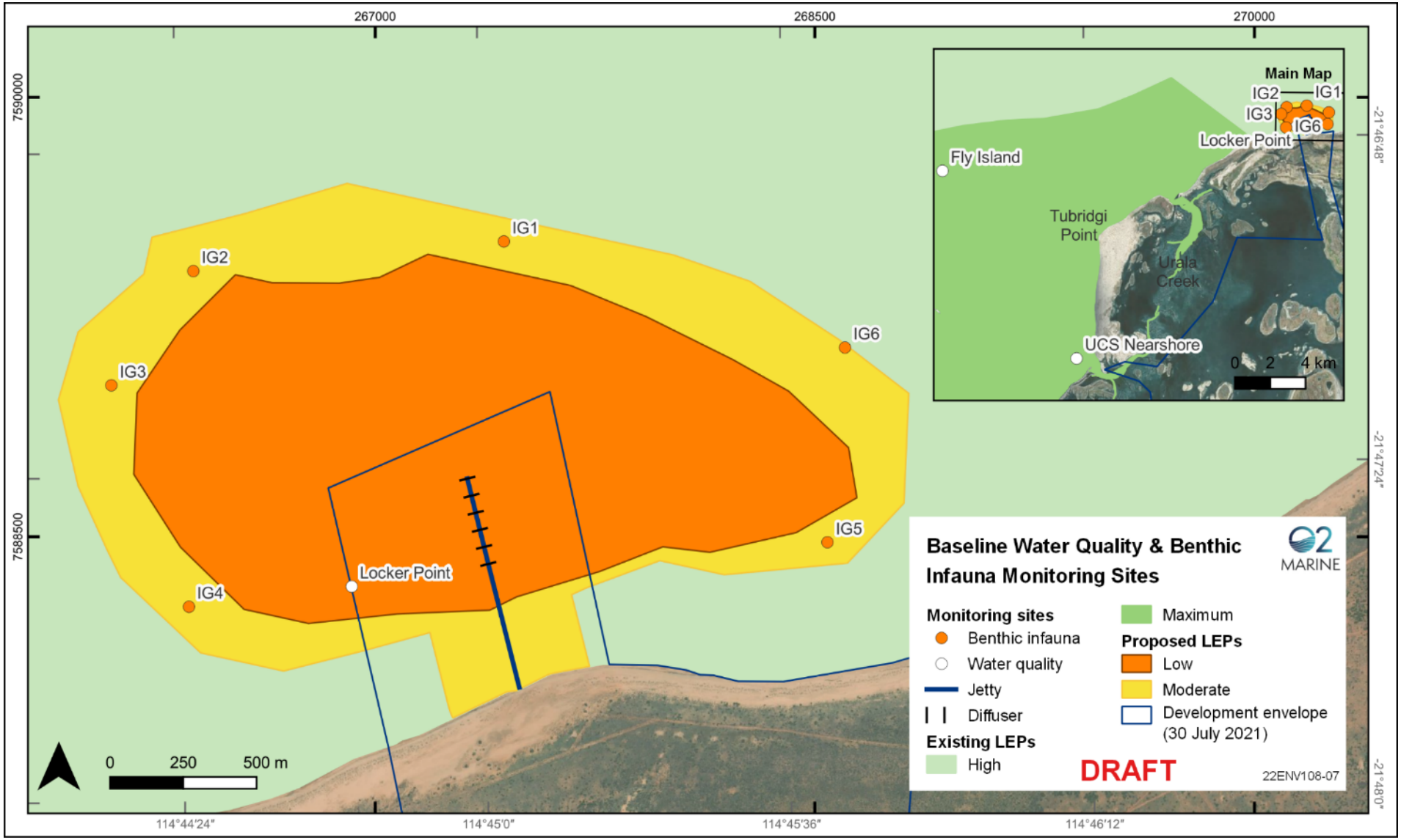


Figure 8 Baseline water quality and indicative benthic infauna monitoring sites

5.4.4. Sampling Methodology

5.4.4.1. Physical Observations

General Observations

The following field observations are to be recorded at each site during each sampling event:

- Date and time of sampling at each location
- Persons conducting the sampling
- Site reference
- GPS coordinates of sampling location
- Tides and water depth at the time of sampling
- Wind speed (km/hr) and direction
- Sea state (i.e. wave and swell heights)
- General weather conditions (rain, storms, cloud cover, etc).

Digital photographs should also be taken throughout the monitoring event as weather conditions change and as required to document any notable site observations. Field logs are to be scanned and attached as an appendix in the quarterly and annual reports.

Aesthetic Observations

At each sampling location, observations of aesthetic water quality parameters should be recorded for each of the categories provided in Table 13. Aesthetic observations are to consider waters within an approximate 50 metre radius of the survey vessel.

Table 13 Aesthetic observation assessment categories and ratings.

Parameter	REF	1	2	3	4	5
Nuisance organisms (Surface coverage %)	A	Nil	1-10	11-50	51-80	100+
Large-scale deaths (Marine fauna)	B	Nil	1-10	11-51	51-81	100+
Oil/Film (Surface coverage)	C	Nil	1-10%	11-50%	51-80%	81-100%
Natural reflectance (Diminished)	E	81-100%	51-80%	11-50%	1-10%	Nil
Objectionable odour	F	Nil	Slight	Moderate	Strong	Offensive
Floating debris, rubbish, surface slicks (Surface coverage %)	G	Nil	1-10	11-50	51-80	100+

5.4.4.2. Physico-chemical Water Quality Monitoring

A pre-calibrated, water quality profiler will be used to collect physico-chemical profiles at all three sampling locations identified within Table 12. As a minimum, the following parameters will be measured at 0.5 metre (m) intervals throughout the water column from 0.5 m below the surface to 0.5 m above the seabed:

- Depth (m)
- Water temperature (oC)

- pH
- Salinity (ppt)
- Electrical Conductivity (mS/cm)
- Turbidity (NTU)
- Dissolved oxygen (% saturation & mg/L).

All recorded measurements will be downloaded to a secure server within 24 hours. The data should be immediately assessed to ensure validity and, any erroneous data should be removed from the analysis as appropriate.

5.4.4.3. Water Sampling

Sample Collection

Water samples will be collected at all three sampling locations as identified within Table 12. Water samples will be collected into a pre cleaned container using a depth-integrated water sampler, pumping the required volume of water commencing at 0.5m above the seabed up to the surface.

Water samples will be collected in suitable (laboratory supplied) bottles and immediately stored on ice for transport to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. All sampling equipment will be cleaned with Decon solution (or equivalent) between sample sites.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are marine water using a waterproof permanent maker. All samples will then be listed on a Chain of Custody (CoC) form to be included with the samples sent to the laboratories.

Laboratory Analysis

General water sample analysis will be performed on samples collected from all three sampling locations. These samples are required to be analysed by a NATA-accredited laboratory for the following:

- Ionic balance:
  - Alkalinity and Hardness
  - Calcium, Magnesium, sodium, potassium cations
  - Chloride, fluoride and sulphate anions
- Hydrocarbons (TRH, TPH and BTEXN)
- Dissolved Metals and Metalloids (Al, As, Bo, Cd, Cu, Hg, Pb, Zn, V).

Field Quality Assurance & Quality Control

All water quality meters are to be in calibration. If monitoring equipment is hired, calibration certificates are to be provided from the supplier. Calibration records are to be saved and attached as an appendix to compliance reports.

The following Quality Assurance & Quality Control (QA/QC) Samples should be collected as described below:

- A duplicate sample is to be collected at the same site as one of the primary monitoring samples. The purpose of the sample is to confirm that the primary laboratory can produce consistent results when analysing the same sample. The site where it was taken is to be recorded but not reported to the laboratory. Ideally it should be collected at a site that is expected to have higher levels of

contamination (based on historic data and potential sources of contamination) as this will confirm a wider range of analytes and reduce the level of instrument error when comparing larger concentrations.

- A field split sample is collected at the same site as the duplicates and sent to a secondary laboratory for analysis. The purpose of this sample is to confirm that intra-laboratory analysis of the sample produces consistent results.
- A rinsate sample is collected to confirm that cross contamination doesn't occur during the sampling processes in the field. The rinsate sample should be taken after the decontamination process of the sample collection container by running deionised water over the container and collecting it in laboratory provided bottles.

Laboratory Quality Assurance & Quality Control

The laboratory used for water sample analysis must be NATA accredited. Comprehensive QA/QC testing of water samples should be undertaken in accordance with NATA accreditation and include testing of laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogate recovery outliers (where applicable).

5.4.4.4. Benthic Infauna

Sample Collection

Grab samples for benthic infauna analysis will be collected at all six locations identified within Table 12. Benthic infauna samples will be collected from a vessel using a sediment grab sampler such as a van-veen grab or similar. Three replicate samples will be collected at each location to provide statistical replication required for adequate analysis of benthic infauna.

The following sample processing steps will occur:

- Once the sample has been recovered it will be released from the grab sampler into a suitable collection tray
- Weigh the sediment sample and record for post sampling data analysis purposes
- Sieve the sediment through a 500 µm sieve using either the saltwater deck wash to remove fine sediment
- All material retained on the sieve, such as coarse sediment and benthic infauna, will be carefully rinsed into suitable pre-labelled containers and preserved with 95-100% ethanol solution.

This process will be replicated to ensure three individual sediment samples are collected from each location to provide sufficient statistical data to allow assessment of variability within each sample location.

Equipment required for the benthic infauna sediment sampling includes the following:

- Suitable sediment grab sampler
- Deck winch
- Deck wash hose
- Sample collection tray
- Funnel (x2)

- 500 µm sieve box
- Suitable sample containers
- Washing bottles
- Waterproof labelling pens
- Decon 90
- 95-100% Ethanol solution.

Laboratory Analysis

Laboratory picking is conducted under a dissecting-microscope, with all benthic infauna being removed from the sediment. Picking quality assurance checks are done on 10% of the total samples, with a 5% picking error rate. If the picking error is above 5% then previous samples are checked, until a satisfactory error rate is met. All picked benthic infauna will be stored in separate sample vials with 70% ethanol. Macroinvertebrates will be identified to Family taxonomic level using a compound microscope.

5.4.5. Data Assessment and Reporting

5.4.5.1. Data Validation

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been entered correctly. Data entry is to be checked and verified against raw data logs and laboratory reports by an independent person.

5.4.5.2. Quality Control

An assessment of quality control data needs to be undertaken and included in all reports including:

- Assessment of field contamination (rinsate, transport blank and method blank)
- Assessment of field variability (duplicate, triplicate or replicate)
- Assessment of lab variability (intra and inter-laboratory duplicates, picking error)
- Laboratory QA/QC results.

5.4.5.3. Data Assessment

During this phase, no commissioning or project related operational activities will occur. Therefore, data collected will not be assessed against EQC.

At the completion of the two-year baseline data collection period a review of the baseline data will be undertaken to derive and determine site specific EQG and EQS for the LEPA, MEPA and HEPA LEP boundaries in accordance with the process outlined in the EQMF (Section 3.2). Site specific EQS will be incorporated into a revised version of this MEQMMP once defined.

5.4.5.4. Reporting

At the completion of each sampling round, a brief summary report will be submitted to LS. A comprehensive report will be compiled at the completion of the two-year data collection period which will include, but not be limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- Timeseries graphs of physicochemical water column profiles

- A table summarising laboratory analysis results
- Timeseries graphs of laboratory analysis results
- Statistical summary of infauna (as per collection frequency)
- An assessment of all data collected against the EQCs
- Presentation of the calculated site specific EQG and EQS in accordance with ANZG (2018)
- Any actions or recommendations resulting from field implementation and assessment of monitoring data.

5.5. Bitterns Discharge Commissioning and Validation

5.5.1. Rationale

A diffuser commissioning period is required to test and refine the bitterns water prior to the operational phase. During commissioning, it is possible that the bitterns being discharged will not meet the design criteria which was initially used to model the dilutions and recirculation to establish an appropriate mixing zone. The end of the commissioning period will be determined when engineering confirms typical operating conditions have been achieved for all facilities and associated infrastructure and monitoring confirms the dilutions and SPLs for each LEP are achieved.

Management during the initial commissioning process is focused on bitterns discharge achieving the desired level of dilution required to achieve MEQ objectives. Where desired levels are not being achieved contingency actions will be implemented to ensure the permanent bitterns outfall discharge process and design are optimised prior to completion of commissioning. These actions that are implemented during commissioning will ensure that the end point for routine operations is a discharge process that meets or exceeds the expected targets. Performance targets have been designed which provide assurance around protecting EVs, but also to ensure appropriate contingency management actions, such as alterations to the process or design, are implemented during this period, thus reducing the potential for long-term issues.

To determine the actual impacts from project related activities to the MEQ, a comprehensive MEQ validation monitoring and management program is required. This program is broken into several smaller components, each of which have different objectives, methodologies and contingency actions. These components are:

- Whole Effluent Toxicity (WET) testing to determine actual discharge toxicity
- Bitterns discharge validation testing to characterise the discharge from the outfall diffuser against design
- EQC and modelling validation monitoring at strategically positioned locations surrounding the outfall to allow an assessment against defined site specific EQC.

Management during validation is focused on ensuring that predicted impacts are commensurate with actual impacts within the respective spatial LEPs, therefore protecting the associated EVs and EQOs. Where desired levels are not being achieved, contingency actions will be implemented to ensure the permanent discharge of bitterns and associated engineering design are optimised for routine operations, and that the Project related activities either meet or exceed the predicted impacts within the defined LEPs.

Once the commissioning validation period has finished, then this section of the program will be considered complete, and the project will move to the ‘Operational Phase’.

Table 14 summarises the monitoring and management program for the commissioning and validation phase.

Table 14 Performance Monitoring and Management Proposed for the Commissioning and Validation Phase.

Rational	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
Whole of effluent toxicity (WET) of final bitterns product is required to confirm the number of dilutions of bitterns required to achieve 90% and 99% SPL at the LEPA/ MEPA and MEPA/HEPA boundary.	Undertake WET testing to confirm toxicity of raw bitterns and calculate dilution factors for species protection.	Following processing plant completion, as soon as bitterns sample is available. AND Whenever composition of bitterns has been permanently changed.	Minimum level of dilution as defined by WET testing to achieve a 90% and 99% SPL at the LEPA/MEPA and MEPA/HEPA boundary (refer to Performance Target 3 in Section 5.5.2.2)	If the performance target is not achieved, then the management response will include, but should not necessarily be limited to: • Investigate the potential sources of higher than predicted toxicity (i.e., chemicals) • If possible, review and adjust processing to reduce bitterns toxicity • Increase the dilution ratio of bitterns water prior to discharge Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	WET testing results will be included and discussed in the commissioning assessment report, which will be completed within two months following completion of commissioning.
Bitterns dispersion modelling and plant performance requires validation during the commissioning and validation phase to determine the optimum outfall discharge operations	Measurement of flow rate and physico-chemical parameters (including salinity and temperature) of bitterns water prior to release	Program should be implemented during commissioning and will include: • Measurements at a location prior to	<u>Prior to Release</u> • Bitterns physical properties and flow rates to be advised based on plant engineering specification (refer to	If the performance target(s) are not achieved, then the management response will include, but should not necessarily be limited to:	Monitoring results will be included and discussed in the commissioning assessment report, which will be completed within two months following

Rational	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
required to achieve the specified number of dilutions at LEPA/MEPA and MEPA/HEPA boundary.	AND In-situ measurement of salinity and temperature near the seabed at the LEPA/MEPA boundary. AND Water column profiles measuring salinity, temperature and depth radiating outwards from the outfall.	release daily for 12-months • In-situ measurements at the seabed once every hour for 12-months. • Water column profiles are required to be taken monthly over the 12-month validation period.	Performance Targets 1 & 2 in Section 5.5.2.2) <u>LEPA/MEPA Boundary</u> • Physico chemical parameters meet EQG criteria defined in Table 15)	• Investigate the cause of exceedance • Undertake equipment inspection, maintenance and calibration as required • Adjust dilution ratio of bitterns water prior to discharge • Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	completion of commissioning.

5.5.2. EQC and Performance Targets and Thresholds

5.5.2.1. Environmental Quality Criteria

In this MEQMMP, EQG are adopted as trigger levels and EQS as thresholds. If monitored values meet the EQG then the EQO are considered to have been met and the EPA Factors protected. If an EQG is exceeded, there is an increased risk that the associated EQO may not be achieved and assessment against the EQS may be required. If an EQS is exceeded, it is considered there is a significant risk that the associated EQO has not been achieved and a management response is required to ensure the EQO is achieved. For the purpose of this validation phase, only comparison against EQG is required.

The preliminary EQGs for the validation phase are presented in Table 15.[2] These EQG are based upon the ANZG (2018) species protection levels for toxicants in water at protection levels commensurate with Table 8. Within this version of the MEQMMP, these are intended as a guide only, and are subject to review at the completion of the Pre-Commissioning Baseline Monitoring Program.

Table 15 Preliminary EQGs for Marine Environmental Quality Validation.

EQI	Units	EQG			
		Low	Moderate	High	Maximum
Temperature pH Salinity Electrical Conductivity Turbidity Dissolved Oxygen	°C ppt uS/cm NTUI %	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8 Where appropriate EQGs will be determined for surface and seafloor.			No detectable change from natural background Impact < reference 95th percentile
Aluminium	(µg/L)	Impact < Reference 99th percentile	Impact < reference 95th percentile	Impact < reference 80th percentile	
Arsenic (III/V)	(µg/L)	Impact < Reference 99th percentile	Impact < reference 95th percentile	Impact < reference 80th percentile	
Boron	(µg/L)	Impact < Reference 99th percentile	Impact < reference 95th percentile		
Cadmium[1]	(µg/L)	36	14	0.7	
Copper[1]	(µg/L)	8	3	0.3	
Lead[1]	(µg/L)	12	6.6	2.2	
Mercury[1]	(µg/L)	1.4	0.7	0.1	
Vanadium[1]	(µg/L)	280	160	50	
Zinc[1]	(µg/L)	43	23	7	
TRH C6-C14	(µg/L)	25	25	25	
TRH C15-C36	(µg/L)	100	100	100	
BTEXN[1] - Benzene	(µg/L)	1300	900	500	

[2] Only EQG for physico-chemical parameters are required during the commissioning and validation phase. Toxicant in water EQG will be used to compare water samples collected during the Ongoing Marine Environmental Quality Monitoring phase (Section 5.6.3).

EQI	Units	EQG			
		Low	Moderate	High	Maximum
- Toluene - Ethylbenzene - Xylene[2] - Napthalene		330 160 150 120	230 110 100 90	110 50 50 50	
Hydroxide Alkalinity as CaCO3 Carbonate Alkalinity as CaCO3 Bicarbonate Alkalinity as CaCO3 Total Alkalinity as CaCO3 Total Hardness as CaCO3	(mg/L)	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			
Total Anions Total Cations Ionic Balance	(meq/L) (meq/L) (%)	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			
Cations: Calcium Magnesium Sodium potassium	(mg/L)	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			
Anions: Chloride Fluoride Sulphate	(mg/L)	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			

5.5.2.2. Performance Targets and Thresholds

Performance targets have been established to inform when contingency measures need to be actioned. Contingency measures are presented in Section 5.5.7 and typically involve investigation into the possible causes of the exceedance, then implementing appropriate corrective actions to eliminate or reduce re-occurrence.

Performance thresholds (related to EQS) do not apply during the validation phase.

Performance Target 1

Performance Target 1 will be based upon the maximum instantaneous or averaged flow rate (daily or hourly) to be determined based upon final engineering design of the processing plant. Performance Target 1 will be exceeded if the assigned performance measure is exceeded, thus enacting contingency management as presented below.

Performance Target 2

Performance Target 2 is based upon maximum discharge concentrations of physico-chemical parameters within the bitterns (prior to release) to be determined by final engineering design. Performance Target 2 will be exceeded if the bitterns physico-chemical parameters exceed the maximum concentrations, thus enacting contingency management as presented below.

Performance Target 3

Performance Target 3 is based on meeting the minimum number of dilutions defined by WET testing to achieve 90% and 99% species protection levels at the LEPA/MEPA and MEPA/HEPA boundary respectively. Performance Target 3 will be exceeded if WET testing identifies that the minimum number of dilutions are not being achieved within defined LEP boundaries, thus enacting contingency management as presented below.

Performance Target 4

Performance Target 4 is defined as the EQCs and are based upon assessment against water quality results recorded from the LEPA/MEPA and MEPA/HEPA boundaries. Water quality data recorded from the designated monitoring locations are to be assessed against the EQCs (see Table 15). Where an exceedance of any of the EQCs occur contingency management as described in the following sections will be required.

5.5.3. Whole Effluent Toxicity Testing

The purpose of WET testing is to identify the specific toxicity of the bitterns wastewater under accredited laboratory conditions, using species selected to be representative of those on site. WET testing results will provide an assessment of the dilution factors required to be achieved on bitterns outfall wastewater to achieve the SPLs applicable within the LEP areas presented in Figure 6.

5.5.3.1. Sampling Design

WET testing will be undertaken as soon as the water quality of the bitterns discharge is considered to be within design specifications, and therefore representative of bitterns characteristics during routine operations. WET testing will be conducted from samples taken directly from the raw bitterns and the results will be analysed in accordance with ANZG (2018) toxicity sampling and testing protocols.

Additional WET testing will also be required at any time during which the operational process is altered, or if constituents of the bitterns are expected to have changed, thus potentially altering the toxicity within the discharge stream.

In accordance with ANZG (2018), toxicity testing is proposed to be undertaken on a minimum of six locally relevant species from five taxonomic groups. Testing will be in accordance with laboratory NATA accredited methodologies and in accordance with ANZG (2018) toxicity sampling and testing protocols. This includes the preferred use of 'chronic' over 'acute' testing. Suggested tests (based on those currently available) for WET testing are listed below:

1. 48-hour larval development test: *Saccostrea echinate* (Milky Oyster)
2. 96-hr toxicity test: *Melita plumulosa* (Amphipod)
3. 8-day Sea anemone pedal lacerate development test: *Aiptasia pulchella*
4. 72-hr sea urchin larval development test: *Heliocidaris tuberculata*
5. 96-hr Fish Imbalance toxicity test: *Lates calcarifer* (Barramundi)
6. 7-hr Fish Imbalance and biomass toxicity test: *Lates calcarifer*
7. 72-hr marine algal growth test: *Nitzschia closterium*.

The WET tests will be confirmed closer to the time in collaboration with the preferred laboratory to ensure appropriateness of the selected tests and to determine availability of the selected species.

5.5.3.2. Sampling Methodology

Samples for WET testing will be collected directly from the raw bitterns prior to any dilutions, at the point directly before it enters the discharge pipe. Samples will be collected in laboratory supplied sample containers and in accordance with sampling instructions and ANZG (2018) protocols. Typically, this involves filling plastic sample bottles (~2.5 L) from the bitterns sump once normal operational processes and discharges are established. Samples are typically required to be chilled and transported to the laboratory within stipulated timeframes. Diluent water will be collected from a source within the HEPA that has been determined to have no impacts from the outfall discharge (i.e., through interpreting modelling results), from a depth equal to the outfall diffuser. Samples will be transported directly to the laboratory to ensure ecotoxicity testing can occur as soon as practicable after sample collection.

5.5.3.3. Data Assessment and Reporting

Ecotoxicity testing results will be entered into a software program (i.e., Burrlioz) to calculate the value required to achieve a 90% SPL at the boundary of the LEPA/MEPA and a 99% SPL at the boundary of the MEPA/HEPA. WET testing results will be assessed against predicted dilution contours to ensure that actual dilution contours required to achieve the 90% and 99% SPLs are being achieved. These results will be used to validate, or as a basis for review and refinement of operational parameter for the reverse osmosis plant.

At the completion of each round of WET testing, a validated laboratory report and summary report will be compiled which will include, but not be limited to:

- A summary of the methods applied and any deviations from the proposed methods
- A table summarising the laboratory results
- An interpretation of the raw data from the software program used (i.e., Burrlioz)
- Analysis of results against predictive modelling with respect to dilution contour modelling and spatial allocation of LEPs with the mixing zone boundary required to meet the 90% SPL
- Any actions or recommendations.

5.5.4. Bitterns Discharge and Flow Rate Monitoring

Daily measurements of temperature and salinity will be collected over the 12-month commissioning and validation period. Measurements will be obtained from the bitterns water prior to release, using a pre-calibrated water quality meter or an appropriate inline sensor.

A flow rate sensor, or similar, will be installed to monitor hourly or maximum instantaneous flow rates representative of the diffuser outfall. Sampling will be conducted continuously throughout the 12-month validation period.

5.5.5. Bitterns Effluent Marine Environmental Quality Validation Monitoring

The purpose of the bitterns effluent MEQ validation monitoring is to provide an assessment of environmental performance to identify if the defined EQCs are being achieved within their respective LEPs. Results will also be assessed to determine if the predicted model dilution factors are being achieved at the LEPA/MEPA boundary. Bitterns discharge validation testing will provide an indication of variability of the bitterns constituents, thus allowing a definitive prediction of the levels of impacts from routine discharges.

These results will be interpreted along with revised dilution factors from WET testing (Section 5.5.3) to further define and revise the EQCs for ongoing operational performance assessment (Section 5.6.2).

5.5.5.1. Sampling Design

The monitoring period will be undertaken as soon as the water quality of the discharge is considered to be within design specifications, and representative of bitterns effluent characteristics during routine operations. Bitterns discharge validation monitoring will be undertaken until the performance targets are achieved, or at a minimum 12 months if they are consistently achieved.

This will require the following sampling programs:

- Continuous in-line flow rate monitoring
- Continuous monitoring of salinity and temperature of the raw bitterns effluent
- In-situ water quality data logging (continuous) in the marine environment
- Monthly physico-chemical water column profiling (radial transects) and physical observations in the marine environment.

Continuous in-situ monitoring sites are placed to help determine the impacts of tidal flow at a higher temporal sensitivity (diurnal), as compared to weekly monitoring. There are two impact sites, DL1 and DL2 (Figure 9). These sites have been positioned at the eastern and western extremes of the LEPA/MEPA boundary, based on the modelled plume dispersion outputs Water Technology (2021b).

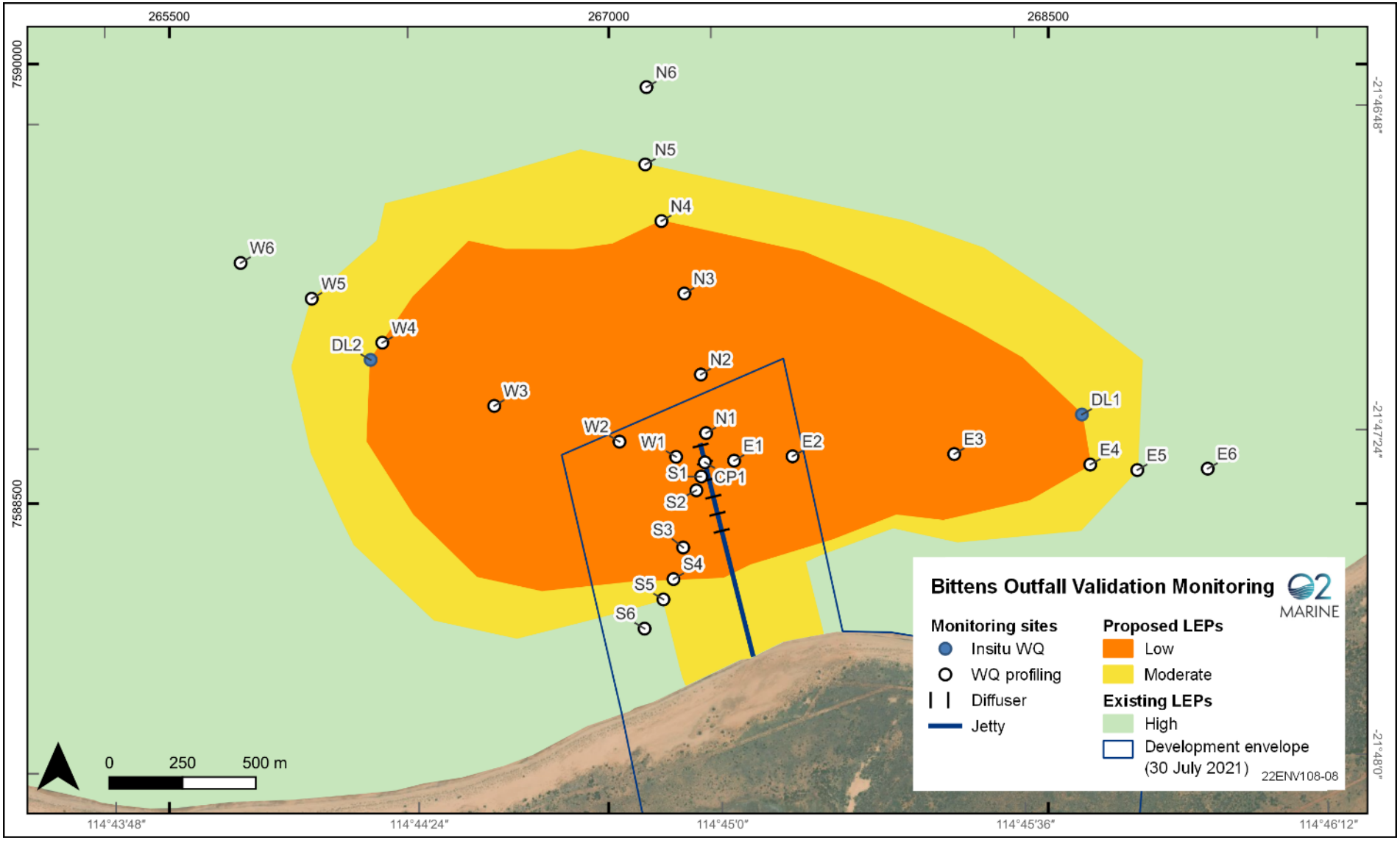
Physicochemical water column profiling will be conducted at all ‘WQ profile’ sites identified in Figure 9 and physical observations will be conducted at all sites. The ‘WQ profile’ sites are monitored to determine exactly where the bitterns dilutions are occurring to validate the modelled predictions.

Details of the monitoring locations and associated sampling tasks to be completed at each location are presented in Table 16 and Figure 9.

Table 16 Marine Environmental Monitoring Locations and Sampling Tasks for the MEQ Validation Phase.

Site Reference	Site Name	Easting	Northing	LEP	Monitoring Parameters		
					Physical observations	Water column Profiling	In-Situ data logging
In-situ Monitoring Stations: These sites are located on the LEPA/MEPA boundary, where the maximum extent of the 90% species protection boundary is predicted. Physico-chemical parameters will be recorded at least every hour for a minimum of six weeks. The sensor will be positioned approximately 0.5 m above the seabed.	DL1	TBC	TBC	LEPA/MEPA	X	X	X
	DL2	TBC	TBC				
Water Quality Profile Sites: These sites are positioned radially from the diffuser location (CP1). Monitoring at these locations will determine the actual plume extent, with results compared to the prediction model. Physico-chemical parameters will be recorded from 0. 5m below the surface, then at 0.5 m intervals until 0.5 m above the seabed.	CP1 E1 E2 E3 E4 E5 E6 N1 N2 N3 N4 N5 N6 S1	TBC	TBC	Variable	X	X	

Site Reference	Site Name	Easting	Northing	LEP	Monitoring Parameters		
					Physical observations	Water column Profiling	In-Situ data logging
	S2 S3 S4 S5 S6						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268500
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7588500
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114°45'36"
114°46'12"
N6
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N3
N2
N1
W6
W5
W4
W3
W2
W1
DL2
DL1
E1
E2
E3
E4
E5
E6
S1
S2
S3
S4
S5
S6
CP1
0
250
500 m
Bittens Outfall Validation Monitoring
MARINE
Monitoring sites
Insitu WQ
WQ profiling
Diffuser
Jetty
Proposed LEPs
Low
Moderate
Existing LEPs
High
Development envelope
(30 July 2021)
22ENV108-08

Figure 9 Indicative bitterns outfall MEQ validation monitoring Locations.

In-situ physicochemical monitoring

Measurements of temperature, salinity, pH and dissolved oxygen will be collected hourly over throughout the 12-month validation period during the bitterns discharge validation phase. The in-situ loggers will be attached to seabed frames maintaining an instrument height of approximately 0.5 m above the seabed. Sensor logging will be set at a maximum of hourly intervals, with data downloaded and instrument maintenance/charging typically required every six weeks (dependant on biofouling conditions and battery life of instrumentation).

Water quality instrument maintenance and calibration will be performed prior to the deployment in accordance with manufacturer specifications and appropriate QA/QC protocols. Any maintenance visits will involve retrieval of the instrument frame, sensor maintenance/charging and then re-deployment, typically within a 24-hr period.

Physicochemical Water Column Profiling

Water quality profiling will occur monthly over a 12 month period. Profiles will be undertaken from 0.5 m below the surface, then at 0.5 m intervals until 0.5 m above the seabed. Water temperature, salinity, pH and dissolved oxygen will be collected at each location along four transects (Figure 9 and Table 16). Two additional profiles will be undertaken at in-situ monitoring sites DL1 and DL2.

Water quality instrument calibration will be performed in accordance with manufacturer specifications and appropriate QA/QC protocols.

5.5.6. Data Assessment and Reporting

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been analysed correctly. Compliance with the performance targets will be conducted as follows:

- Flow rates sensor measurements compared directly against Performance Target 1
- Daily bitterns temperature and salinity will be compared directly with Performance Target 2
- Water column profiles will be interrogated to compared directly against the Performance Target 4
- In-situ data assessment from DL1 and DL2 will include calculation of a daily median for each parameter, to be compared directly against Performance Target 4.

A 'Water Quality Validation Report' will be compiled at the completion of the validation phase which will include, but not be limited to:

- A summary of the methods applied and any deviations the method presented herein
- Timeseries graphs and tables of physicochemical parameters
- An assessment of daily data collected against performance targets
- A review of performance target exceedances, investigations and remedial actions implemented
- Any actions or recommendations arising from the validation phase.

5.5.7. Contingency Management

If the performance targets are not achieved, then the management response will include, but may not be limited to:

- Investigate the cause of the exceedance or potential sources of the exceeding physico-chemical parameter
- Undertake equipment inspection, maintenance and calibration as required
- If possible, review and adjust operational process to amend bitterns toxicity
- Increase the dilution ratio of bitterns water prior to discharge
- Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.

An overview of the contingency management response is outlined below in Figure 10. Management response actions are required to be implemented with 7 days of notification of a performance target exceedance.

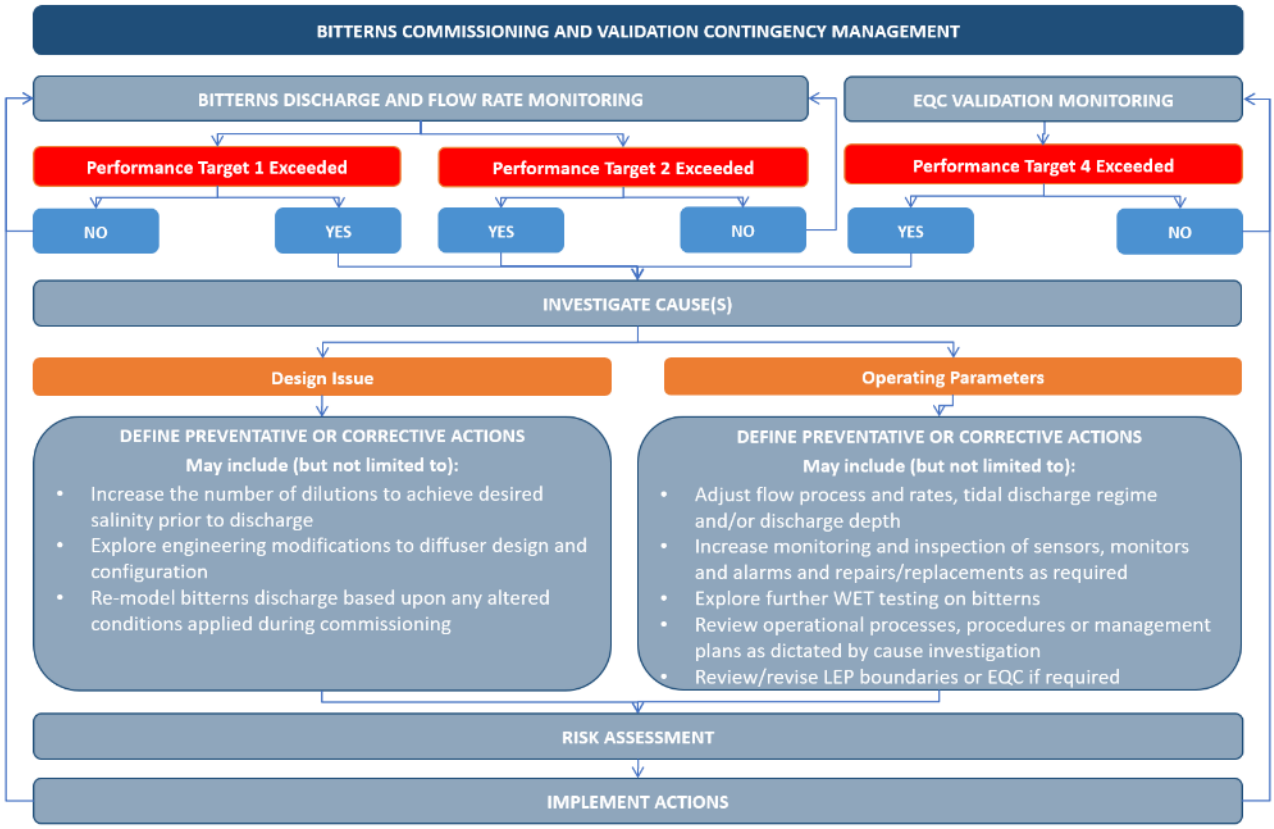

Figure 10 Contingency Management Framework for Bitterns Discharge Commissioning and Validation.

5.6. Routine Marine Environmental Quality Monitoring

5.6.1. Rationale

Once the validation phase is completed, the routine MEQ monitoring program will be implemented for the remainder of the Project lifecycle. This phase comprises the following two components:

1. Ongoing assessment of bitterns discharge quality against design specifications
2. Ongoing MEQ monitoring (water quality and sediment quality) to ensure that potential impacts from operational activities are occurring within the limits of allocated within each spatial LEP.

Management during ongoing operations will be focused on ensuring that the validated levels of impact within the defined spatial LEPs continue to be achieved, and therefore protect the associated EVs and EQOs. Where desired levels are not being achieved, contingency actions will be implemented to ensure the impacts are restricted, investigated and remediated. Contingency compliance reporting will be required to identify exceedances and associated EQOs at risk, any contingency actions implemented, and any proposed changes to management actions. These reports will be submitted as required to the regulator.

Table 17 Monitoring and Management proposed during Routine Operation of the Ashburton Salt Project.

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	Timing/ Frequency					
Physical constituents in water Toxicants in Water	<u>Ongoing Bitterns Discharge Monitoring</u>						
	Measurement of outfall bitterns salinity and temperature prior to release together with measurement of discharge flow rate.	At least daily throughout operations.	Physical properties and flow rates prior to release meet Performance Targets 1 & 2 presented in Section 5.6.2.3	In the event of <u>EQG exceedance</u>, management response may include, but should not necessarily be limited to: Investigate the cause of exceedance within 24 hours. > Undertake asset performance monitoring, maintenance and calibration as required > Adjust dilution ratio of bitterns prior to discharge > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	Performance Threshold is based on final EQS (Section 5.6.2.2 andTable 20).	In the event of <u>EQS exceedance</u>, management responses will include, but not be limited to: Investigate the cause of exceedance. > Review and adjust operational process to reduce bitterns toxicity > Increase the dilution ratio of bitterns water prior to discharge > Slow down or stop discharge operations.	<u>Routine</u> > Monitoring results to be included in routine operational reports – monthly > Operational reports to be included with annual compliance report <u>Investigative</u> > An EQG investigation report will be prepared and submitted one month following EQG exceedance > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance > AN EQS exceedance investigation report will be prepared and submitted to the regulator one month following a recorded exceedance.
	<u>Ongoing Marine Environmental Quality Monitoring</u>						
	Undertake MEQ monitoring as per Section 5.6.3	As per frequency outlined in Table 21.	Assess MEQ results against Performance Target 3 in Section 5.6.2.3	In the event of <u>EQG exceedance</u>, conduct and investigation to the likely cause within 24 hours. Re-sample MEQ sites within 1 week if source of exceedance not identified.	Performance Threshold is based on final EQS (Section 5.6.2.2 andTable 20).	In the event of <u>EQS exceedance</u>, undertake investigative monitoring program (benthic infauna and BCH – refer Section 5.6.4.5 within 4 weeks of confirmed EQG exceedance from reactive monitoring program	<u>Routine</u> > Quarterly summary reports will be provided one month following receipt of laboratory results. <u>Investigative</u> > An EQG investigation report will be prepared and submitted one

							month following EQG exceedance. > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > AN EQS exceedance investigation report will be prepared and submitted to the regulator one month following a recorded exceedance.
Toxicants in Sediments	<u>Routine</u> Collection of sediment samples from all sites presented in Figure 12 to monitor impacts from bitterns discharge and port operations. Raw metals results are compared to the EQGs <u>Reactive</u> EQG exceedance triggers elutriate and bioavailability testing. These results are compared against the EQGs.	Sediment samples collected annually for three years following commissioning and then five yearly thereafter.	<u>Routine</u> Performance Target 3 (Section 5.6.2.3) requires pooled raw metals and normalized hydrocarbon data to be compared against the EQGs which are the ANZG (2018) default guideline values. <u>Reactive</u> Performance Target 3 (Section 5.6.2.3) requires elutriate and bioavailability data to be compared against the EQGs which are the ANZG (2018) default guideline values.	In the event of <u>EQG exceedance</u>, management response may include, but should not necessarily be limited to: <u>Investigative Monitoring</u> Conduct investigative monitoring for benthic infauna within 4 weeks of confirmed EQG exceedance from reactive monitoring program <u>Cargo Handling Operations</u> > Conduct operational audit to ensure compliance with document processes > Conduct facility inspection > Review cargo handling loading parameters (weather, load rates, dust suppression, product moisture etc).	Performance Threshold is based on final EQS (Section 5.6.2.2). Investigative monitoring data collected is to be compared against EQS.	In the event of <u>EQS exceedance</u>, management responses will include, but not be limited to: > Investigate the cause of exceedance > Review product handling/loading parameters (weather, load rates, dust suppression, product moisture etc) > Conduct operational audit to ensure compliance with document processes > Conduct facility inspection.	<u>Routine/Reactive - EQG</u> > Annual or five yearly sampling summary report to be completed within three months of field sampling activities <u>Investigative</u> > An EQG investigation report will be prepared and submitted one month following EQG exceedance. > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > AN EQS exceedance investigation report will be prepared and submitted to the regulator one month following a recorded exceedance.

5.6.2. Environmental Quality Criteria Performance Targets

5.6.2.1. Environmental Quality Guidelines

The preliminary water quality EQG values used for the routine monitoring phase are outlined Table 15. At the completion of the baseline monitoring program and the validation phase, these will be reviewed accordingly and the final set of EQGs included in this Section (Section 5.6.2.1)

The preliminary EQGs for sediment quality are presented within Table 18. Where levels are elevated, additional testing for bioavailability is required. EQGs for bioavailability testing are presented in Table 19.

Table 18 Preliminary Sediment EQGs for Routine Marine Environmental Quality Monitoring.

EQI	Units	EQG			
		Low	Moderate	High	Maximum
Aluminium[1]	mg/kg	6150	4100	4100	No detectable change from natural background
Arsenic[1]	mg/kg	20	20	20	
Boron	mg/kg	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			
Cadmium[1]	mg/kg	1.5	1.5	1.5	
Copper[1]	mg/kg	65	65	65	
Lead[1]	mg/kg	50	50	50	
Mercury[1]	mg/kg	0.15	0.15	0.15	
Vanadium[1]	mg/kg	54	36	36	
Zinc[1]	mg/kg	200	200	200	
TRH[2] C6-C14 C15-C36	mg/kg	250 25 100	250 25 100	250 25 100	
TPH[3]	mg/kg	280	280	280	
BTEXN[1] - Benzene - Toluene - Ethylbenzene - Xylene[2] - Napthalene	mg/kg	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7 and as outlined within Table 8			

Table 19 Preliminary EQGs for Sediment Toxicity Bioavailability Assessment

EQI	Units	EQG	
		Moderate	High
Arsenic[1]	mg/kg	20	20
Cadmium[1]	mg/kg	1.5	1.5
Copper[1]	mg/kg	65	65
Boron	mg/kg	Median within 80th percentile of reference range	
Lead[1]	mg/kg	50	50
Mercury[1]	mg/kg	0.15	0.15
Vanadium[1]	mg/kg	Median within 80th percentile of reference range	
Zinc[1]	mg/kg	200	200
TRH[2]	mg/kg	C6-C9: 25 C10-C14: 25 C15-C28: 100 C29-C36: 100 TRH: 250	C6-C9: 25 C10-C14: 25 C15-C28: 100 C29-C36: 100 TRH: 250

5.6.2.2. Environmental Quality Standards

The EQS used in this MEQMMP (Table 20)are based on levels of acceptable change in biological or ecological indicators (EPA 2016). Sampling for assessment against EQSs is reactive program required at any time that the routine monitoring program identifies exceedances above the final EQG. The EQS have been established from EQI constituents identified in Section 4.5 which include:

- Physico-chemical stressors in water (e.g. salinity, temperature, dissolved oxygen)
- Toxicants in water
- Toxicants in Sediment.

The EQS take into consideration the following biological conditions:

- Bioaccumulation/Bioconcentration of toxicants in biota
- Condition of BCH
- Condition of Benthic Infauna

Table 20 Environmental Quality Standards for routine operational operations.

EQI	Receptor	EQS		
		Moderate	High	Maximum
Physico-chemical stressors in water	Biological indicator (e.g., seagrass, coral, filter feeders and benthic infauna)	No loss or decline within BCH greater than 95% percentile of natural conditions	No change in BCH communities from natural conditions	No loss or decline within BCH greater than 95% percentile of natural conditions
		No loss or decline within benthic fauna communities greater than 95% percentile of natural conditions	No change in benthic fauna communities from natural conditions	No loss or decline within benthic fauna communities greater than 95% percentile of natural conditions
Toxicants in Sediment/Water	Biological indicator (e.g., seagrass, coral, filter feeders and benthic infauna)	No loss or decline within BCH greater than 95% percentile of natural conditions	No change in BCH communities from natural conditions	
		No loss or decline within benthic fauna communities greater than 95% percentile of natural conditions	No change in benthic fauna community composition as compared to natural conditions	
	Bioaccumulation/ Bioconcentration of toxicants	No EQS Apply	80th percentile of tissue toxicant concentrations in filter feeders compared with suitable reference site	No detectable change in tissue toxicant concentrations from natural background levels

Figure 13 presents the relationship between EQG exceedances and EQS reactive sampling programs which are required to be implemented. Reactive sampling programs are required to determine the extent and severity of any impacts and provide an assessment of whether the EQOs are compromised and if the EVs are at risk.

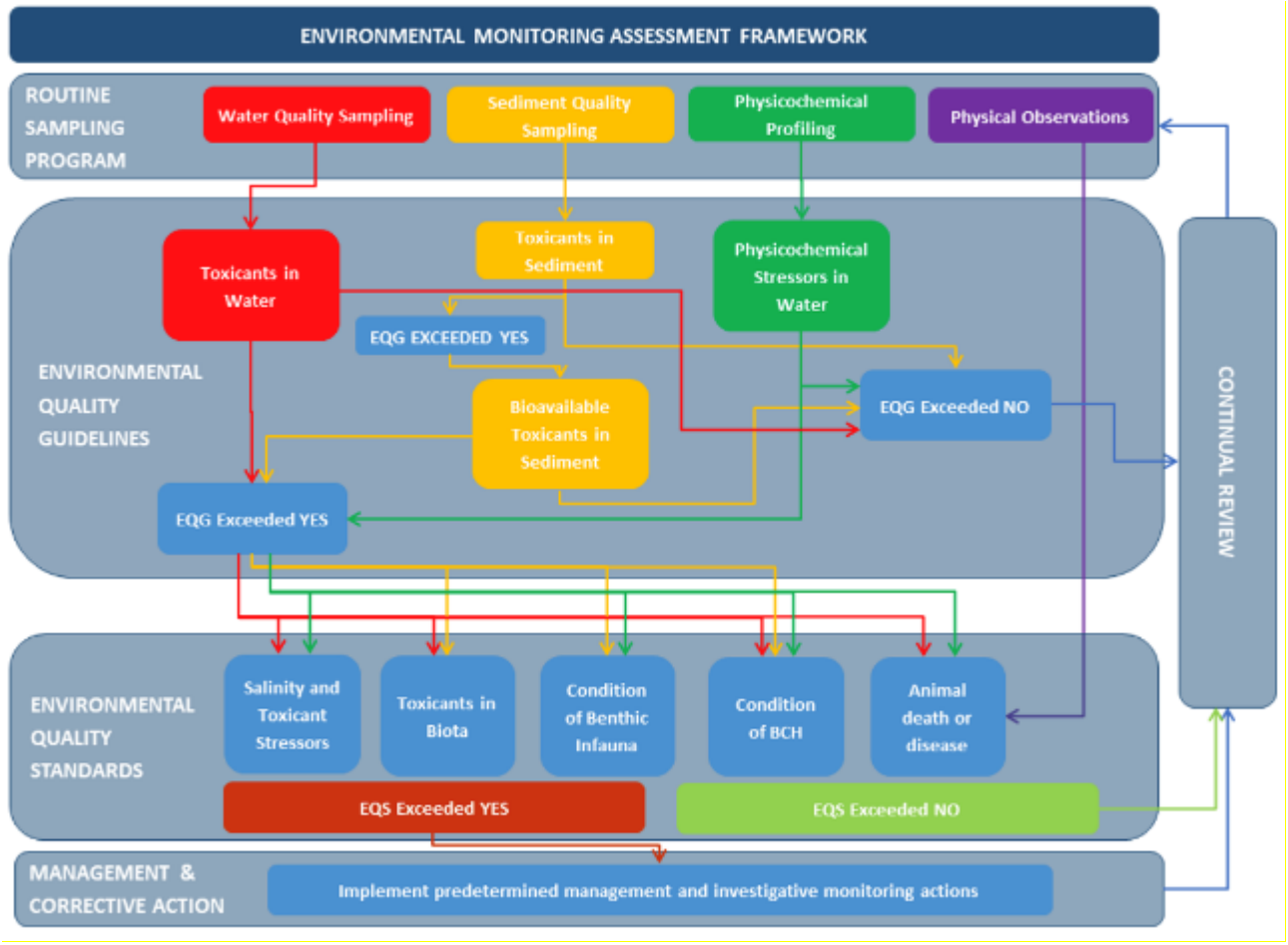

Figure 11 Routine Marine Environmental Quality Monitoring and Assessment Framework

5.6.2.3. Performance Targets and Thresholds

Performance Targets are based upon instantaneous flow rates, the maximum predicted design concentration for constituents within the raw bitterns discharge and the EQC defined within Table 15 , Table 18, Table 19 and Table 20.

A Performance Threshold is defined based upon the EQS and identifies the point where the EQOs may not be met and the EVs are considered at risk from the Project operational activities. Where these are exceeded, compliance investigation and reporting are required as detailed below.

Performance Target 1

Performance Target 1 will be based upon the maximum instantaneous or averaged flow rate (daily or hourly) to be determined during the validation period. Performance Target 1 will be exceeded if the assigned performance measure is exceeded for more than seven consecutive days, thus enacting contingency management as presented below.

Performance Target 2

Performance Target 2 is based upon maximum discharge concentrations of temperature and salinity within the bitterns to be determined by during the validation period. Performance Target 2 will be exceeded if the

maximum concentration within the raw bitterns is exceeded for more than seven consecutive days, thus enacting contingency management as presented below.

Performance Target 3

Performance Target 3 is defined as the EQGs and are based upon assessment against MEQ samples and data collected at the LEPA/MEPA or MEPA/HEPA boundaries or within the LEPs. MEQ samples and data collected from designated sampling locations are to be assessed against the defined EQGs as identified in Table 15 and Table 18. Where any EQGs are exceeded contingency management actions as detailed below are required.

Performance Threshold

The Performance Threshold is defined as the EQSs and are based upon assessment against MEQ samples and data collected at the LEPA/MEPA or MEPA/HEPA boundaries or within the LEPs. MEQ samples and data collected from designated sampling locations are to be assessed against the defined EQSs as identified in Table 20. Where an exceedance of any of the EQSs occur and investigation, contingency management and compliance reporting will be required.

5.6.3. Ongoing Bitterns Discharge Monitoring

The purpose of the ongoing bitterns discharge monitoring is to ensure that design specifications for bitterns discharge constituents, as verified through bitterns discharge and flow rate monitoring, are achieved through the lifecycle of the Project.

5.6.3.1. Sampling Design and Methodology

Bitterns discharge quality monitoring will be conducted for the Project lifecycle in accordance with Section 5.5.5.

5.6.3.2. Data Assessment and Reporting

Data collected will require immediate comparison with Performance Targets 1 and 2 identified above. Any elevation will require contingency actions as described below.

Data Validation and Quality Control

All data is required to be validated prior to the release of any monitoring reports to confirm that data is accurate and that sensors or sampling equipment is properly functioning and calibrated.

Reporting

An investigation report will be compiled in accordance with the K+S's Environmental Management System (or similar) for any elevated results which require investigation. Submission to the regulator will be subject to project approval conditions.

An annual compliance report will be submitted to the regulator which will include, but not be limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- An assessment of all data collected against performance targets
- A review of performance targets exceedances investigations and remedial actions implemented
- Any actions or recommendations required as a result of field implementation of the MEQMMP and assessment of monitoring data.

5.6.3.3. Contingency Management

If the treatment process is not meeting the desired performance target levels, a range of operational and design solutions will be investigated. Firstly, depending upon the exceedance, an investigation needs to be undertaken to determine the cause(s). Once the cause(s) is determined then appropriate corrective or preventative actions need to be put into place to ensure re-occurrence does not occur. This system of investigation and implementation of remedial actions will ensure that optimal performance of the process continues through the lifecycle of the project.

There are several potential operational and design solutions which may be used as contingency measures in response to performance target exceedances, examples of these operational and design modifications are summarised in Figure 10.

5.6.4. Ongoing Marine Environmental Quality Monitoring

The purpose of the ongoing MEQ monitoring program is to collect quantitative data to assess against performance targets to ensure that impacts from operational activities (excluding bitterns discharge – see Section above) do not impact MEQ outside the limits of acceptable ecological change for each LEP. The key Project operational activities that have potential to put MEQ at risk are:

1. Port operations (hydrocarbon spills, nearshore and offshore product loading)
2. Seawater intake and related activities
3. Adjacent landside activities

5.6.4.1. Sampling Design

The ongoing MEQ monitoring will commence following the completion of the bitterns outfall and WET testing validation. This monitoring program involves the collection of physical observations, physico-chemical profiles, water sampling and sediment sampling. Table 21 shows the MEQ monitoring events and sampling frequencies, number of monitoring sites and commencement timeframe.

Table 21 Monitoring Events and Frequency for the Ongoing Marine Environmental Quality Monitoring.

Monitoring Event	Frequency	No. Sample Sites	Commencement
Physical Observations	Quarterly	12	Post 12 month validation period
Physico-chemical Water Quality Profiling	Quarterly	7	Post 12 month validation period
Water Sampling	Quarterly	7	Post 12 month validation period
Sediment Sampling	Annually	5	Post 12 month validation period

Details of the ongoing MEQ monitoring sites are presented in Table 22 and shown in Figure 12.

Table 22 Ongoing Marine Environmental Quality Monitoring Locations.

Site Reference	Site Name	Easting	Northing	LEP	Monitoring Parameters			
					Physical observations	Water column Profiling	Water Sampling	Sediment Sampling
MEQ Sampling Sites These sites will monitor potential impacts from port operations such as hydrocarbon spills, nearshore and offshore product loading and sediment disturbance from vessels. Four reference sites have been included for comparative purposes.	MEQ1 MEQ2 MEQ3 MEQ4 REF1 REF2 REF3 REF4	TBC	TBC	TBC LEPA MEPA HEPA XEPA	X	X	X	X
Sediment Sampling for Product Spill Annual sediment samples will be undertaken in these locations to assess potential toxicants in sediment resulting from product spill.	SS1 SS2 SS3	TBC	TBC	TBC LEPA MEPA HEPA XEPA	X			X

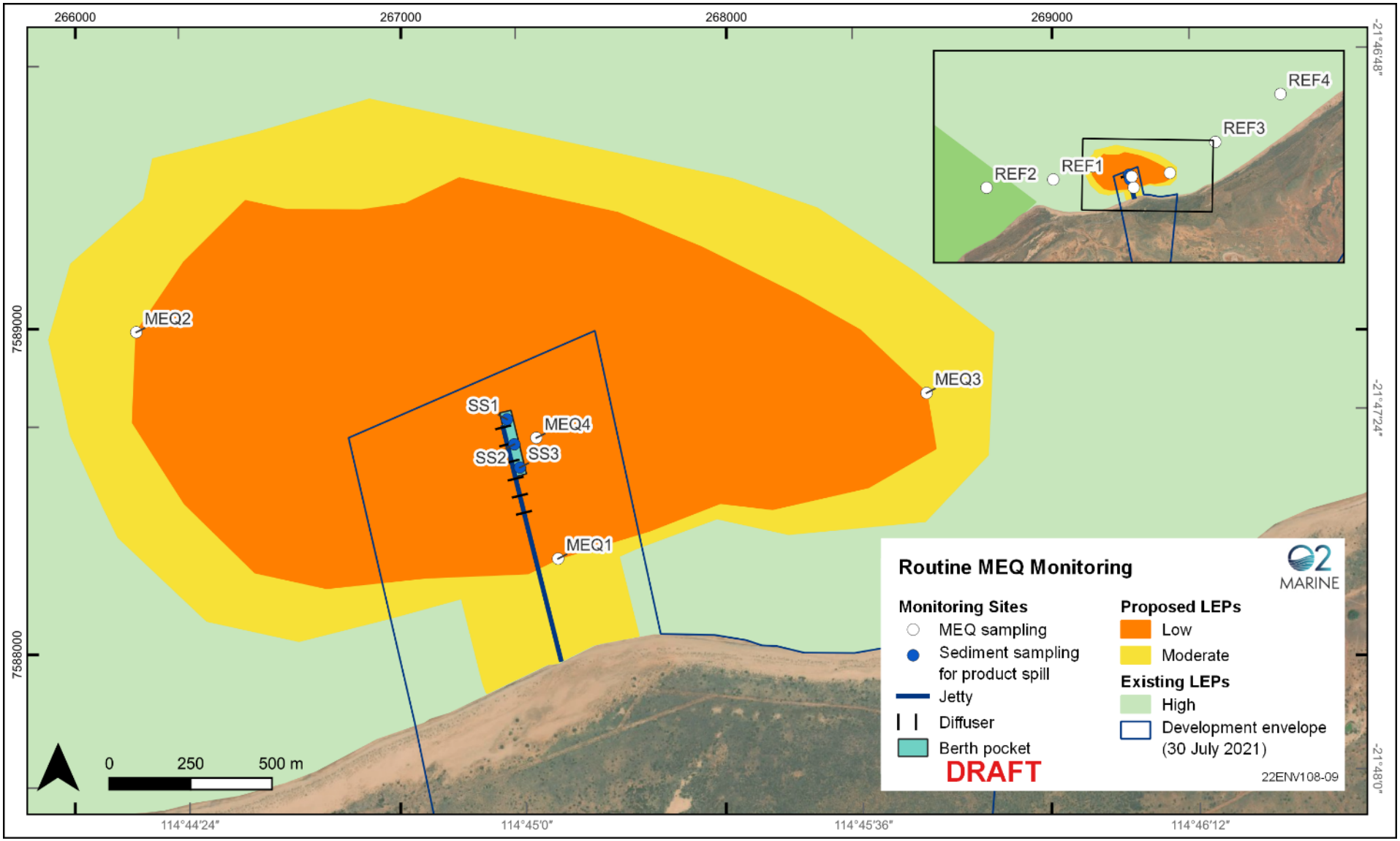

Figure 12 Location of the Ongoing Marine Environmental Quality Monitoring Sites

5.6.4.2. Sampling Methodology

Sampling methodologies for physical observations, physico-chemical profiling will be conducted in accordance with the methodologies outlined in Section 5.4.4. No benthic infauna sampling is proposed during the ongoing monitoring program[3]. Sediment sampling will be undertaken in accordance with the below methodologies.

Water Quality Sampling

Water samples will be collected at the seven sampling locations identified within Table 22. Water samples will be collected from three separate depths, as required to validate and identify modelled stratification. The following samples will be collected:

- 0.5m below surface
- Middle of water column
- 0.5m above seafloor.

Samples will be collected using an electronic water sample pump or niskin bottle to collect the required volume of water from each of the depths identified above.

The water sampler will be rinsed with Decon solution (or equivalent) between samples. Water samples will be collected in suitable (laboratory supplied) bottles and immediately stored on ice for transport to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are marine water using a waterproof permanent maker. All samples will then be listed on a Chain of Custody (CoC) form to be included with the samples sent to the laboratories.

Water samples will be sent to a NATA accredited laboratory for analysis of salinity and a broad suite of toxicants which be used to further refine and define the final EQCs for ongoing monitoring programmes. Laboratory QA/QC requirements will be undertaken in accordance with the NATA accreditation and reported with the sample results.

Laboratory analysis of water samples will include:

- Ionic balance
  - Alkalinity and Hardness
  - Calcium, Magnesium, sodium, potassium cations
  - Chloride, fluoride and sulphate anions
- Hydrocarbons (TRH, TPH and BTEXN)
- Dissolved Metals and Metalloids (Al, As, Ba, Bo, Br, Cd, Cu, Hg, Li, Mo, Pb, Sr, Zn, V).

[3] Unless in relation to reactive EQS investigations, whereby methodologies described in Section 5.4.4.4 will be implemented.

Field Quality Assurance & Quality Control

All water quality meters are to be in calibration. If monitoring equipment is hired, calibration certificates are to be provided from the supplier. Calibration records are to be saved and attached as an appendix to compliance reports.

The following Quality Assurance & Quality Control (QA/QC) Samples should be collected as described below:

- A duplicate sample is to be collected at the same site as one of the primary monitoring samples. The purpose of the sample is to confirm that the primary laboratory can produce consistent results when analysing the same sample. The site where it was taken is to be recorded but not reported to the laboratory. Ideally it should be collected at a site that is expected to have higher levels of contamination (based on historic data and potential sources of contamination) as this will confirm a wider range of analytes and reduce the level of instrument error when comparing larger concentrations
- A field split sample is collected at the same site as the duplicates and sent to a secondary laboratory for analysis. The purpose of this sample is to confirm that intra-laboratory analysis of the sample produces consistent results
- A rinsate sample is collected to confirm that cross contamination doesn't occur during the sampling processes in the field. The rinsate sample should be taken after the decontamination process of the sample collection container by running deionised water over the container and collecting it in laboratory provided bottles.

Sediment Quality Sampling

Sediment samples will be collected at all five sampling locations described in Table 22. Sampling will involve the collection of sediment using a surface grab via a van veen grab sampler (or similar). The grab, plastic tray and other equipment in contact with the sediment will be rinsed with Decon solution and seawater prior to sampling each site to reduce potential for contamination. Where insufficient sediment is collected (i.e. less than 1/3rd of grab volume), the grab will be required to be redeployed. Estimate and record the volume of sediment collected and empty the grab into a plastic tray to mix and homogenise the sediment. Photograph each sample once emptied into the plastic tray. Place sample into appropriate sample jars/ containers provided by laboratory. Containers should be refrigerated or placed into an esky with ice bricks before frozen at the completion of each sampling day and sent to a NATA approved laboratory.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are marine water using a 'Wet-write' permanent maker. All samples will then be listed on a CoC form which will accompany the samples sent to the laboratories.

All sediment samples will be analysed by a NATA-accredited laboratory for the following analytical suite:

- Particle size distribution (PSD)
- Total organic carbon (TOC)
- Moisture
- Metals and metalloids (Al, As, Bo, Cd, Cu, Hg, Pb, Zn, V)
- Hydrocarbons (TRH, TPH and BTEXN)

- Antifoulant Compounds (Diuron, Chlorothalonil).

Field Quality Assurance & Quality Control

Disposable nitrile gloves should be used during handling of the sediment sample and all equipment in contact with the sediment should be washed down with Decon solution prior to each sample being taken. The following QA/QC Samples should be collected as described below:

- Triplicate samples (i.e. three separate samples taken with the sediment grab at the same location) should be taken at one (1) site to determine the variability of the sediment physical and chemical characteristics
- A field split sample (i.e. one sediment grab sample thoroughly mixed and then split into three sub-samples) should be collected at collected at one (1) site to assess inter and intra-laboratory variation, with one of the three samples sent to a second laboratory
- A transport blank (acid-washed silica sand) in a sealed jar should be provided by the laboratory and taken to site but not opened. The transport blank is sent back to the laboratory with the other samples and analysed. This blank is used to assess if any contamination is already present in the acid-washed sand or container
- A method blank (acid-washed silica sand) should be used to assess the potential for contamination during the sampling process. The method blank should be placed into the 'van Veen' grab and processed identically to the usual sediment samples. The method blank should be sent to the laboratory and analysed with the other samples to assess presence of contamination during the processing procedures.

5.6.4.3. Laboratory Quality Assurance & Quality Control

Laboratories used for water and sediment toxicity sample analysis must be NATA accredited. Comprehensive QA/QC testing of samples should be undertaken in accordance with NATA accreditation and include testing of laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogate recovery outliers (where applicable).

5.6.4.4. Toxicant Bioavailability Assessment

Elevated toxicants in sediment may be present in a variety of forms, however, only the bioavailable fraction will impact organisms. Bioavailability testing assesses the availability of elevated toxicants present within sediments for the uptake of organisms. Where total toxicants from routine sediment analysis identify exceedances of the EQGs outlined within Table 18, a bioavailability analysis is required for assessment against EQGs presented in Table 19.

Bioavailability tests comprise dilute acid extraction of toxicants under laboratory conditions. Therefore, additional samples should be collected during routine sediment sampling to facilitate any additional testing that may be required. If toxicant concentrations from bioavailability tests exceed the EQGs (Table 19) further ecotoxicity or bioaccumulation testing will be required for comparison against established EQS.

5.6.4.5. Reactive Environmental Quality Standard Sampling Methodologies

Sampling for assessment against EQSs is a reactive program required at any time the routine monitoring program identifies exceedances above the final EQGs. Reactive sampling programs are required to determine

the extent and severity of any impact and provide an assessment of whether the EQOs are compromised and if the EVs are at risk.

Toxicants in Biota

The objective of bioaccumulation monitoring is to determine if toxicants are bioaccumulating at a rate that could affect marine life and/or result in seafood being not safe for human consumption.

Initially, a desktop study will be undertaken to determine the risk of contaminant bioaccumulation across the Project study area. The desktop study will review the concentrations of any contaminant(s) that have exceeded the bioavailable EQSs, and whether the contaminant is likely to bioaccumulate in locally relevant species. Guidance procedures and assessment for bioaccumulation testing will follow Simpson et al. (2005) and in the American Society for Testing Materials (ASTM) International guide E1688 (2016), Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates.

One or both of the following methods will be used for monitoring toxicants in biota, as appropriate:

- Field collected and caged/transplanted organisms
- Laboratory based bioaccumulation test sampling.

Direct field collected and caged/transplanted organisms can be tested for any toxicants accumulating in tissues of organisms at the affected site, then comparing results with organisms of the same species located at one or more reference sites. Field collected samples rely on existing information on the concentrations of contaminants that have exceeded the relevant EQSs prior to the detection of elevated levels, whereas caged/transplanted organisms involve the deployment of relevant species (usually filter-feeding bivalves) at the affected and reference sites to measure the change in the contaminants that have exceeded the relevant EQC over time. An appropriate gut depuration interval is generally required (typically 24 hours) prior to analysis although the specific requirements should be discussed with the laboratory.

Laboratory bioaccumulation tests generally run for 28 days and use several test species. At least two bioaccumulation tests should occur, preferably on a bivalve mollusc and burrowing polychaete (Simpson et al., 2005). The requirements for these species are similar to toxicity testing, where each species should provide adequate biomass for analysis, ingest water/sediments and be efficient metabolisers of contaminants. However, the organisms do not need to be sensitive to the contaminants that are under investigation for bioaccumulation potential.

The location, nature and frequency of reactive monitoring required will be tailored on advice from appropriate specialists for the collection of the appropriate information required to inform any management responses to specific exceedance events. Consideration will be given to the utilisation of historical data as well as physical and chemical sediment data.

For any contaminant where bioaccumulated concentrations are statistically greater than that measured in the controls, an investigation into the source of the contaminant will be conducted. Where environmental and public health risks are identified as a possibility, the appropriate government agencies will be notified accordingly.

Benthic Communities and Habitat

BCH monitoring will be required if it is identified that relevant EQGs have been exceeded. A thorough review of the Project BCH Report (AECOM 2022a) will be undertaken to understand monitoring locations, methodologies and baseline conditions. Additional monitoring sites may be required to adequately assess specific impacted areas. Monitoring typically involves qualified divers recording photos and taxonomic information over repeatable and measured transects. It should be noted that BCH is known to have natural seasonal variability, as such, multiple BCH surveys (including suitable reference sites) may be required to accurately determine natural or anthropogenic changes.

Benthic Infauna

Benthic infauna sampling will be conducted in accordance with the methods and at the sample locations presented within Section 5.4.4.4.

Data obtained during the sampling will be assessed against the EQS presented in Table 20.

5.6.4.6. Data Assessment and Reporting

Data Validation

All data will be validated prior to the release of any monitoring and assessment reports. Data used or otherwise presented in the reports is to be checked and verified against raw data logs and laboratory reports.

Quality Control

An assessment of data quality control will be undertaken, which includes:

- Assessment of field contamination (rinsate, transport blank and method blank)
- Assessment of field variability (duplicate and triplicate)
- Assessment of lab variability (triplicate)
- Laboratory QA/QC results.

Data Assessment

Laboratory samples and in-situ results will be compared with the performance targets as soon as practicable to ensure that the appropriate reactive monitoring programs are implemented immediately following any EQC exceedance. Elevated results will be assessed in accordance with Figure 11 to determine the level of management actions or investigative monitoring required.

Reporting

An investigation report will be compiled in accordance with K+S Salt Australia's EMS (or similar) for any elevated results which requires management response in accordance with Figure 13. Submission to the regulator will be subject to project approval conditions.

A comprehensive report will be developed at the completion of each monitoring round which will include, but not be limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- Timeseries graphs of physicochemical water column profiles
- A table summarising laboratory analysis results
- Timeseries graphs of laboratory analysis results

- An assessment of all data collected against performance targets
- A review of performance targets exceedances investigations and remedial actions implemented
- Any actions or recommendations resulting from field methodologies and or assessment of results.

5.6.4.7. Contingency Management

If the Project operational related activity contributes to an exceedance of the defined performance targets, a tiered risk-based investigative process will be required as defined within Figure 13. Figure 14 provides the management contingency actions required.

Depending on the exceedance, an investigation needs to be undertaken to determine the cause(s), as per monitoring components in Figure 13.

Once the cause(s) is determined then appropriate corrective or preventative actions need to be put into place to ensure re-occurrence does not occur. This investigation process, and the implementation of remedial actions, will ensure that optimal environmental performance continues through the lifecycle of the Project.

In the event of an EQS exceedance, the CEO of DWER will be notified and a report provided to the CEO within 3 months describing any subsequent investigations, implemented management actions, and an assessment of the success of these actions in returning MEQ to acceptable levels.

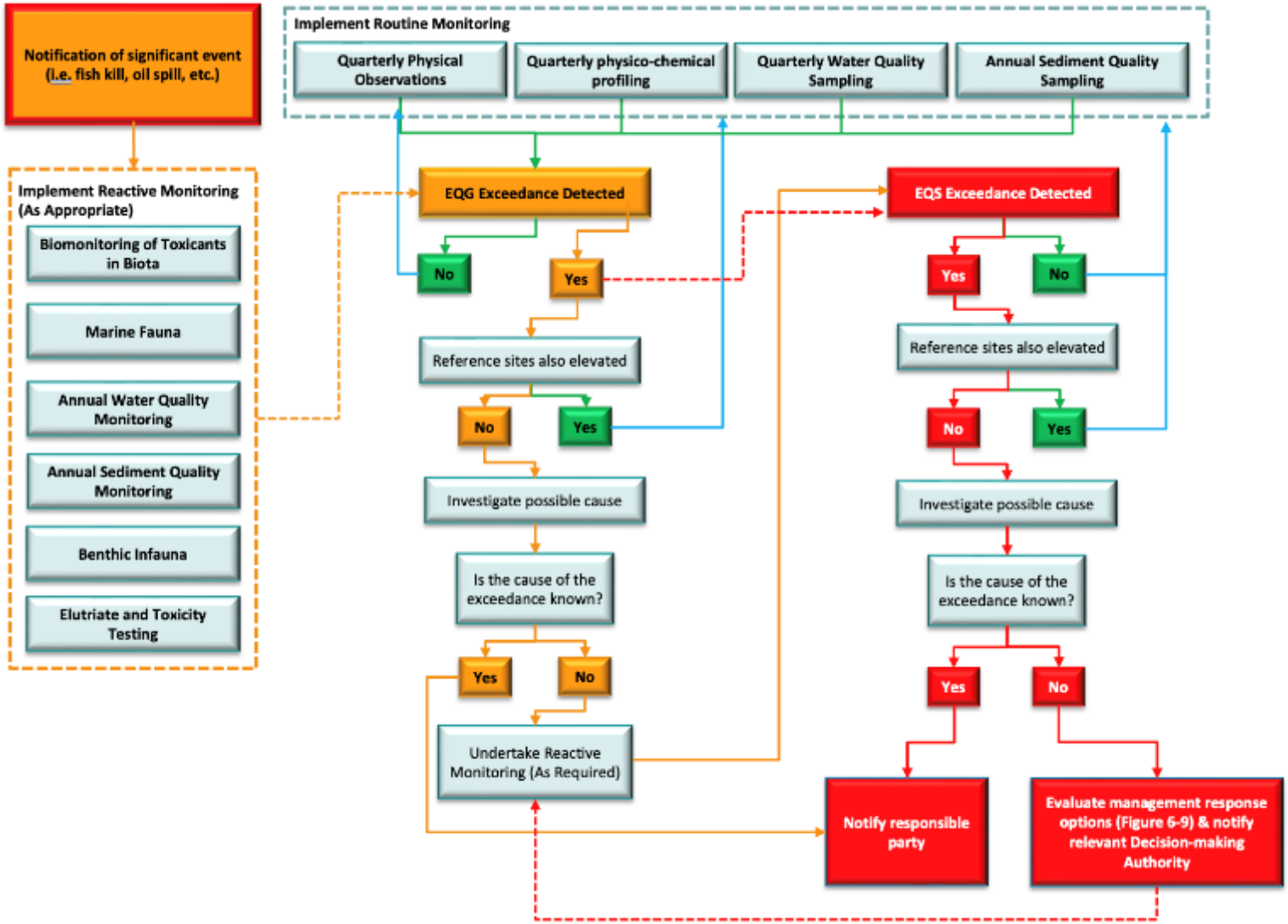

Figure 13 Management Response Framework from the Ongoing Marine Environmental Monitoring Program.

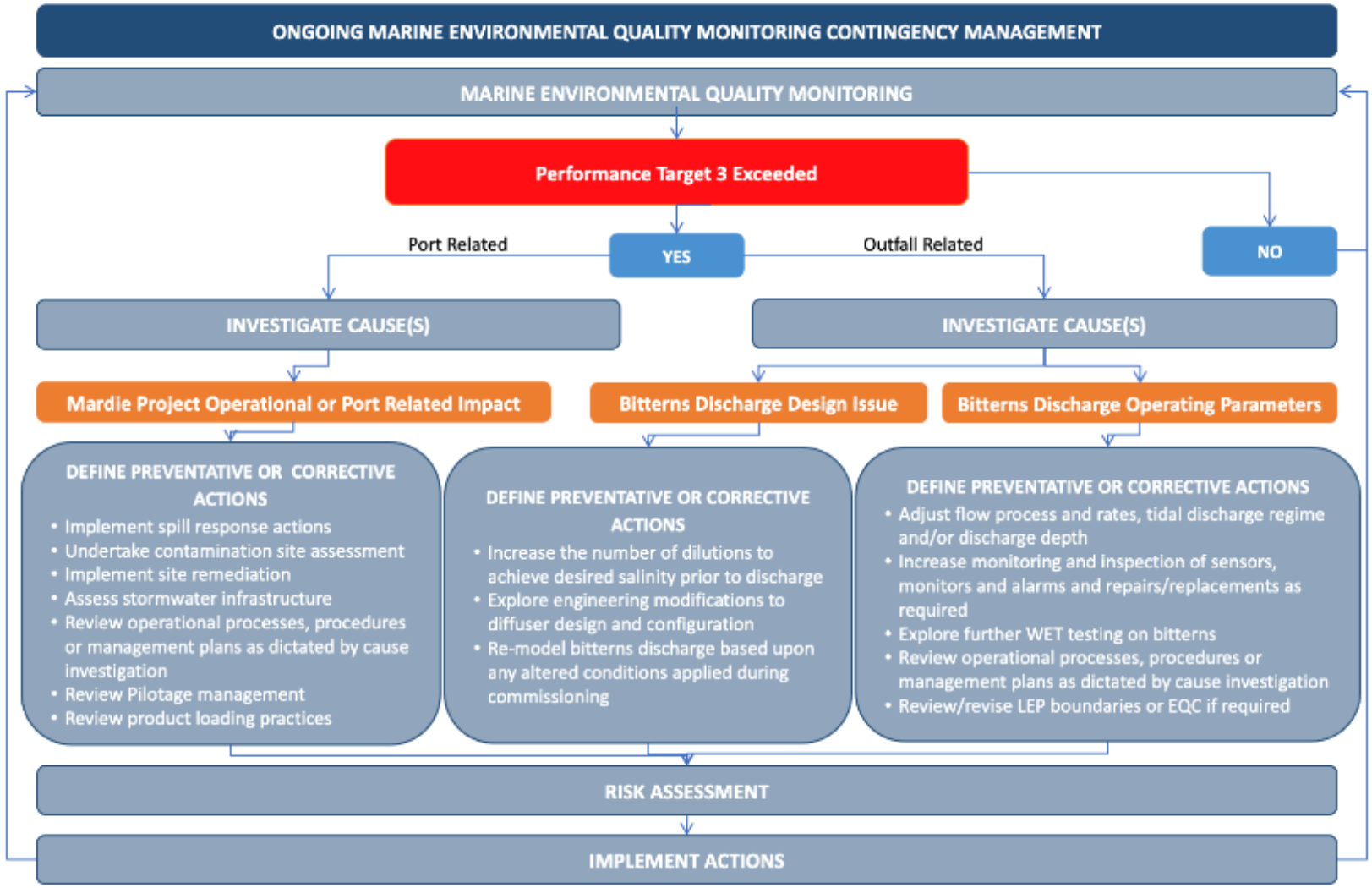

Figure 14 Contingency Actions for the Ongoing Marine Environmental Quality Monitoring Program.

5.7. Product Storage and Handling Monitoring and Management

5.7.1. Rationale

An integral operational component of the Project is the storage and handling of high saline product. It is a requirement to implement regular monitoring and management to ensure all saline product is appropriately contained both on land, and within the marine environment. Failure to adequately contain the high saline product has the potential to impact MEQ via four key components:

1. Spillage from the concentrator and crystalliser ponds into drainage and creek systems
2. Spillage from trenches/culvers or transfer pipelines into drainage and creek systems
3. Spillage during product loading to transhipment vessels at the end of the trestle jetty
4. Spillage during product loading from transhipment vessels to ocean going vessels at offshore mooring areas.

An overview of the Product Storage and Handling Monitoring and Management program is outlined in Table 23.

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Table 23 Overview of the Product Storage and Handling Monitoring and Management Program

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
Achieve zero spills of brine water into the marine environment from concentration ponds and crystallisers.	• Ensure concentration pond design includes materials to limit brine seepage and rip rap protection where necessary to prevent wave action from causing a breach to the external walls. • Ensure external walls have been designed with sufficient internal freeboard to contain brine depth variations and rainfall from extreme weather events. • Ensure ponds are constructed and operated in accordance with approval conditions under the *Mining Act 1978* and Part V of the EP Act. • General Works department to operate earthmoving equipment to undertake levee repairs as necessary. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	Operational monitoring: • Scheduled inspections of pond walls, pond freeboard and drainage ditches and levees. Environmental monitoring: • Internal Audit Programme. Contractor management: • Monitor earthmoving contractors' obligations in accordance with contracts. • Monitoring in accordance with Licence/Approval conditions.	Operational and closure phase. Operational monitoring: • Daily Environmental monitoring: • Monitoring in accordance with Licence/Approval conditions. Contractor management: • In accordance with contracts. • In accordance with conditions.	Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual). Contractor: Earthworks service provider/contractor: Monthly reports that include, but are not limited to: • Earthmoving volumes. • Safety statistics including reportable incidents, near misses, and interventions. • Issues and innovations.
Achieve zero spills of brine water into the marine environment from transfer trenches, culverts and/or pipelines.	• Ensure trenches have been designed with sufficient internal freeboard to contain brine depth variations and rainfall from extreme weather events. • Ensure level monitoring systems are adopted to measure trench levels, and flow controls are installed. • Ensure hypersaline pipelines are bunded and/or double cased when outside pond boundaries to ensure containment of spills OR ensure pipeline pressure/flow leak detection monitoring is installed. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	Operational monitoring: • Scheduled inspections of transfer trenches, culverts and pipelines. Environmental monitoring: • Internal Audit Programme. Contractor management: • Monitor earthmoving contractors' obligations in accordance with contracts. Monitoring in accordance with Licence/Approval conditions.	Operational phase. Operational monitoring: • Daily Environmental monitoring: • In accordance with Approval conditions. Contractor management: • In accordance with contracts. • In accordance with conditions.	Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual). Contractor: Earthworks service provider/contractor: Monthly reports that include, but are not limited to: • Earthmoving volumes. • Safety statistics including reportable incidents, near misses, and interventions. • Issues and innovations.
Achieve zero spills of salt product into the marine environment from product loading system to transhipping vessels.	• Ensure engineering control systems are designed to ensure the loading system cannot discharge unless transhipping vessels are moored alongside the product loading jetty. • Ensure discharge chutes are designed and operated to minimise windborne salt dust. • Ensure diligent operation to ensure that loading is immediately ceased if spillage occurs. • Ensure spillage at the loading jetty is minimised through the use of conveyor belt scrapers at conveyor transfer/discharge points. Ensure any spillages that	Operational monitoring: • Scheduled inspections and routine maintenance of product loading systems and vessels. Environmental monitoring: • Internal Audit Programme. • Sediment sampling to test for toxicants, with results compared against EQC in Table 18 and Table 19.	Operational phase. Operational monitoring: • Daily Environmental monitoring: • In accordance with Approval conditions. • Annually	Internal: • Incident reporting (as required). • Operations reporting (monthly). • Annual MEQ report summarising all water and sediment quality results. External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual).

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
	do occur are hosed to landside soak-away points or stockpiled for periodic recycling or disposal to inland facility. • Develop, implement, and maintain risk identification procedures and operational controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement sediment sampling at 'Sediment Sampling Sites for Product Spillage' in Figure 12, with the methodologies and frequency outlined in Section 5.6.4.2 Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.			
Achieve zero spills of salt product into the marine environment from product loading system from transhipping vessels to ocean-going vessels.	• Ensure transhipping vessels have a fully enclosed recovery system for product pick-up from the hold through to the integral boom discharge into the ocean-going vessel. • Ensure product loading only takes place when weather conditions allow safe mooring of the transhipping vessel alongside the ocean-going vessel to ensure controlled product discharging can occur. • Develop, implement, and maintain risk identification procedures and operational controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement sediment sampling at 'Sediment Sampling Sites for Product Spillage' in Figure 12, with the methodologies and frequency outlined in Section 5.6.4.2 Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	Operational monitoring: • Scheduled inspections and routine maintenance of product loading systems and vessels. Environmental monitoring: • Internal Audit Programme. • Sediment sampling to test for toxicants, with results compared against EQC in Table 18 and Table 19.	Operational phase. Operational monitoring: • Daily Environmental monitoring: In accordance with Approval conditions.	Internal: • Incident reporting (as required). • Operations reporting (monthly). • Annual MEQ report summarising all water and sediment quality results. External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual).

5.7.2. Routine Inspections and Audits

During Project operations, daily inspections (via inspection checklists) will be undertaken for all facility infrastructure involved in the storage and handling of high saline product. Inspections will include, but not be limited to:

- Bund walls
- Piping
- Pump stations
- Drainage infrastructure
- Conveyor belts.

Regular audits (at a frequency to be stipulated by approval conditions) will be implemented to ensure daily inspections are occurring, and that any corrective actions have been actioned in acceptable timeframes. Audits will also ensure all processes and system documentation is up to date and available to all operational personnel.

5.7.3. Marine Environmental Quality Monitoring

As part of the ongoing marine environmental quality monitoring program (Section 5.6.4), annual sediment sampling will be undertaken in proximity to where salt product is loaded to transhipment vessels at the end of the trestle jetty, and as required following any confirmed product spill at the indicative offshore anchorage area where transhipment vessel load salt product into ocean going vessels. This sediment monitoring is aimed at assessing potential impacts to MEQ against EQC defined in 5.6.2. from the spillage of salt product. In the event that impacts have been identified contingency management will be undertaken as per Figure 14.

5.7.4. Emergency Product Spill Response

An 'Emergency Product Spill Response Procedure' (or similar) will be developed that incorporates all operations that involve the storage or handling of high saline product. Regular audits (at a frequency to be stipulated by approval conditions) will ensure procedures have been developed, inductions and training have been provided to appropriate personnel, and that plant and equipment is readily available for spill management.

Incident reporting will be undertaken to the ISO 14001:2015 Standard (Table 23).

5.8. Hydrocarbon Monitoring and Management

5.8.1. Rationale

Vessels are required for the transport of the product to other locations around the world. The potential sources of hydrocarbon spills to the marine environment from the Project include:

- vessel discharges
- vessel spills – e.g. hydraulic fluids or fuel from piling barge or dredge
- vessel collisions
- refuelling or maintenance of the transhipper.

Mitigation measures to reduce the potential for releases of hydrocarbons to the marine environment include:

- Implementation of Marine Order 30 (prevention of collisions) 2016 of the Commonwealth *Navigation Act 2012*, including:
  - adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar).
  - adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity.
  - adherence to navigation noise signals as required.
- Implementation of Marine Order 21 (safety of emergency arrangements) 2016, including:
  - adherence to minimum safe manning levels.
  - maintenance of navigation equipment in efficient working order (compass/radar).
  - navigational systems and equipment required are those specified in Regulation 19 of Chapter V of Safety of Life at Sea.
  - Automatic Identification System (AIS) that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.
- Marine Order 91 (marine pollution prevention—oil) 2014, requires Shipboard Oil Pollution Emergency Plan (SOPEP) (as appropriate to vessel class).
- Notification of dredging and piling activities and movements to allow generation of navigation warnings (Maritime Safety Information Notifications [MSIN] and Notice to Mariners [NTM]).
- Spill kits positioned in high risk locations on the jetty and on vessels.
- Project vessels will have self-containing hydraulic oil drip tray management systems.

The management actions proposed to minimise potential impacts associated with hydrocarbon spill are described in Table 24.

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Table 24 Overview of the hydrocarbon monitoring and management program

Activity	General Vessel Operations					
Potential Impacts	• Altering of the diversity, geographic distribution and viability of fauna at the species and population levels • Degradation of the structure, function, distribution, diversity and viability of benthic communities and habitat at local and regional scales.					
Management Targets	Management Actions		Environmental Performance			
	Item	Actions	Responsibility	Reporting/Evidence	Timing	Contingency
Manage vessel bunkering, chemical storage and spill response to ensure no adverse impacts to the marine environment.	5.1	Document vessel bunkering management, including appropriately licensed bunkering facilities	Contractor	Vessel management procedures	Prior to dredge entering Western Australian Waters from overseas or interstate.	Dredge operations not to commence prior to development and Proponent approval of vessel bunkering management procedure
	5.2	Undertake vessel maintenance and bunkering in accordance with dredging contractors approved vessel management systems	Contractor	Vessel management procedures	For the duration of dredging	Vessel bunkering management systems to be reviewed and refined (if required) in the event of an identified procedural breach or hydrocarbon spill
	5..3	Implement industry standard hydrocarbon management practices (chemical handling, storage, segregation and spill response)	Contractor	Vessel management procedures K+S and DoT are to be notified immediately in the event of a hydrocarbon spill of any volume	Prior to commencement of dredging	Dredge operations not to commence prior to development and approval of vessel management procedures Investigate spill event and review management actions and responses
	5.4	Undertake an environmental inspection of all dredging vessels	Contractor	Vessel management procedures	Prior to the commencement of dredging	Dredge operations not to commence prior to development and approval of vessel management procedures

6. Review

This MEQMMP is a living document and will be regularly reviewed in accordance with Table 25 to ensure it remains relevant to the Project and aligns with industry best practice.

Table 25 MEQMMP Review Timeframes for the Ashburton Salt Project.

Timing	Rationale
Scheduled Review	
Upon receipt of Approval Conditions	Ministerial Statement approval conditions obtained will necessitate a comprehensive review of this MEQMMP to ensure all relevant aspects are covered within this Plan to ensure compliance.
Upon completion of Pre-commissioning Baseline Data Monitoring Program	This review is required to derive the site specific EQCs for the ongoing assessment of impacts, along with any other findings that require update upon completion of the baseline data collection phase.
Upon Completion of Commissioning	This will typically be required to update management triggers associated with the discharge design for the bitterns wastewater.
Upon Completion of Validation assessment	A comprehensive review of the LEPs and EQC will be required based upon data obtained during this phase. A comprehensive review of the entire MEQMMP will be required to ensure adequacy for management of the ongoing MEQ with respect to the final operational processing facility.
Annually during routine operations	At the completion of annual reporting requirements any recommendations for alteration of the MEQMMP will need to be incorporated into a revised version suitable for the next 12 months of operations.
Ad-Hoc Review	
Any time operational activities significantly alter	Operational changes to the project may result in an altered risk profile. Therefore, the MEQMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.
Any time Bitterns discharge quality or regime alters	Process or design alterations changes to the bitterns discharge may result in an altered risk profile. Therefore, the MEQMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.

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