Yannarie Solar
a **Straits** initiative

ENVIRONMENTAL REVIEW &
MANAGEMENT PROGRAMME

VOLUME TWO

Management Programme

NOVEMBER 2006

Yannarie Solar
a Straits initiative

ENVIRONMENTAL REVIEW &
MANAGEMENT PROGRAMME

VOLUME TWO

Management Programme

November 2006

Straits Salt Pty Ltd
1st Floor, 35 Ventnor Avenue
West Perth WA 6005
ACN: 107 118 570

Cover Photograph Acknowledgements
Biota: Sandpipers
Oceanica: Whales

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

Chapter 1

Environmental Management Programme

Chapter 1 Environmental Management Programme

1 INTRODUCTION

The Yannarie Solar project entails the construction and operation of a 10 Mtpa solar saltfield on the eastern margin of the Exmouth Gulf, Western Australia. The project is designed to meet the rapidly growing global demand for salt. This Environmental Management Programme is designed to address potential impacts to the environment and provide management actions to mitigate these impacts.

In summary, the key components of the proposal are:

- construction of the infrastructure
- abstraction of salt water from Dean's Creek (southern field) and Naughton Creek (northern field) to produce up to 10 Mtpa of salt for the domestic and export markets.

The required infrastructure is:

- approximately 41,000 ha of evaporation ponds along the salt flat
- crystallisers ponds
- barge harbour
- office/workshop infrastructure
- haul and access roads
- washplant
- borrow pits for material construction
- conveyor.

1.1 CORPORATE ENVIRONMENTAL POLICY

Straits commitment towards the environmental management of all its activities is outlined in its Environmental Policy.

Straits has developed an Environmental Management System (EMS) for its current operational business units and will adapt the current EMS for the construction and operational phases of the salt project, which will conform to the requirements of the International Standard ISO 14001.

1.2 PURPOSE AND SCOPE OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The overall purpose of the Environmental Management Programme (EMP) is to describe measures to protect key environmental features that may be affected by the construction and operation of the proposal. This Programme addresses the following component phases of the project:

- construction and operation of the southern field and associated infrastructure
- construction and operation of the northern field.

The overall objective of this EMP is:

> *To ensure that appropriate management measures or controls are applied to reduce environmental risks and mitigate potential environmental impacts.*

This EMP has been prepared for the purpose of the environmental assessment and approval process. The plans relate to construction of infrastructure and will be further developed to provide detail suitable for use by construction personnel. These more detailed management plans will together form a Construction Environmental Management System (CEMS) and reflected in a Construction Environmental Management Plan.

The management plans presented in this Volume are indicative of the management controls that will be applied but will be developed further and submitted for approval (in line with commitments provided in Volume 1) if the project receives approval from the Minister for the Environment under Part IV of the *Environmental Protection Act 1986.*

2 ENVIRONMENTAL MANAGEMENT PROGRAMME STRUCTURE

The EMP divides the component management plans in line with the two distinct phases of the project which are:

- construction of the infrastructure
- operation of the salt field.

Each component management plan:

- defines EPA objectives and decision making criteria for the factors it addresses
- summarises the potential impacts of the proposal
- describes management measures required to give effect to the environmental commitments and to achieve environmental objectives related to the environmental factor
- provides a description of monitoring and review processes to evaluate compliance to environmental commitments and objectives related to environmental aspects associated with construction and operation of the salt field
- provides a description of the contingencies for unexpected adverse outcomes.

The management plans contained here are related to both the construction and operating phase of the project and will be developed to provide detail suitable for use by construction personnel.

2.1 MANAGEMENT PLANS

The following component management plans have been identified for the construction and operational phases providing the basis for meeting the objectives of the EMP:

- Terrestrial Vegetation Management Plan
- Terrestrial Fauna Management Plan
- Marine Management Plan
- Groundwater Management Plan
- Surface Water Management Plan
- Acid Sulphate Soil Management Plan
- Aboriginal Sites Management Plan.
- Preliminary Closure Management Plan

These component management plans are discussed in Chapter 2.

A construction and operational management plans will be prepared and submitted to the EPA for approval and will address environmental aspects of the proposal expected to arise during those phases of the project.

2.1.1 Construction

A construction environmental management system (CEMS) will be developed and detail the environmental aspects and impacts of the proposal and management controls developed with input from public and stakeholder consultation and the requirements of DOIR, DEC and the EPA. The CEMS will contain more detailed procedures that can be used directly by construction contractors. Relevant mitigation and contingency procedures will be included in the CEMS should environmental management guidelines be breached.

The Construction Environmental Management Plan (CEMP) will describe the CEMS and will complement the above management plans for the construction phase of the project. The CEMP will be submitted to the EPA for approval prior to works commencing on site, and will outline the management measures, strategies and methods that will be used by Straits to ensure effective management of all environmental aspects relating to the construction of the infrastructure.

The CEMS will be reviewed regularly to ensure that environmental objectives are being met and to ensure that the relevant environmental issues are being appropriately managed.

2.1.2 Operation

An Operation Environmental Management System (OEMS) will be developed and detail the environmental aspects and impacts of the proposal and management controls developed with input from public and stakeholder consultation and the requirements of DEC and the EPA. The OEMS will contain more detailed procedures that can be used directly by construction contractors. Relevant mitigation and contingency procedures will be included in the OEMS should environmental management guidelines be breached.

The Operational Environmental Management Plan (OEMP) will describe the OEMS and will complement the operational components the above management plans, The OEMP will be submitted to the EPA for approved prior to operation, and will outline the management measures, strategies and methods that will be used by Straits to ensure effective management of all environmental aspects relating to the construction of the infrastructure.

2.2 INCIDENT RESPONSE

A detailed incident response procedure will be prepared and addressed in the CEMP and OEMP to manage incidents that are significant or potentially significant. The procedure will address the following:

1. Responsibilities and accountabilities of contractor and Straits personnel for incidents
2. Definition of an incident
3. A procedure to be followed in the event of an incident including:
    - incident reporting time limits
    - structure and content of incident reports
    - assessment of significance of incidents
    - discontinuation of work giving rise to the incident
    - recording of incidents (incident log)

- when further investigations are required
- reporting of incidents to regulatory authorities
- remediation or mitigation of impacts
- identification of opportunities for improvements to work practices to minimise the potential for incidents to recur.

Construction contractors will be required to prepare and submit to Straits an incident response procedure that addresses the above measures.

2.3 RESPONSIBILITIES

2.3.1 Construction environmental management

Environmental management is the responsibility of all Straits personnel and contractors. Overall environmental management during the construction phase will be the responsibility of the Project Manager. The responsibilities of the Project Manager will be to:

- implement the Straits Environmental Policy with respect to this project
- understand environmental requirements and ensure compliance
- recommend environmental objectives and targets
- assign the individuals responsible for environmental management, who will then have direct access to the site managers
- direct the activities of Straits employees, contractors and subcontractors to ensure that environmental performance requirements are met
- obtain goods and services that conform with relevant legal, permit and contract requirements, accepted standards, and Straits specifications
- ensure that management aims and monitoring responsibilities relating to the project areas are met
- provide information and training to Straits employees, contractors and sub contractors regarding their environmental obligations
- liaise with contractors, other Straits staff, Government agencies and the public as required.

2.3.2 Operational environmental management

Overall environmental management during the operational phase will be the responsibility of the Operations Manager.

The responsibilities of the Operations Manager will be to:

- implement the Straits Environmental Policy with respect to the operation
- understand environmental requirements and ensure compliance
- set environmental objectives and targets
- assign the individuals responsible for environmental management, who will then have direct access to the site managers

- direct the activities of Straits employees, contractors and subcontractors to ensure that environmental performance requirements are met
- obtain goods and services that conform with relevant legal, permit and contract requirements, accepted standards, and Straits specifications
- ensure that management aims and monitoring responsibilities relating to the operational areas are met
- provide information and training to Straits employees, contractors and subcontractors
- liaise with contractors, other Straits staff, Government agencies and the public as required.

2.4 AUDITING

Internal auditing is an important part of implementing an EMP to ensure that specified management procedures are complied with and performance criteria are met. Where auditing identifies non-conformances, corrective action will be taken.

Straits will appoint an environmental representative to conduct or supervise environmental audits during and following construction in accordance with an audit plan. The audit team will include Straits officers and independent auditors.

Straits will prepare an audit plan following receipt of environmental approval of the proposal. The audit plan will include:

- timing and frequency of audits
- scope and types of environmental audits (system, process compliance, site and facility audits)
- audit procedure
- rating system (if any)
- structure and content of audit reports
- audit protocols or guidelines to be used
- facilities and processes to be audited
- composition of audit teams
- training for audit team members
- responsibilities for audits.

Contractors will be required to carry out environmental audits to check their own internal environmental performance and procedures. These audits will be in addition to any carried out by Straits.

Liaison with Department of Environment and Conservation (DEC), Department of Water (DoW), Department of Consumer and Employee Protection (DoCEP), and relevant local authorities will be conducted during the preparation of the audit plan.

2.5 PUBLIC REPORTING AND TRANSPARENCY

Straits will prepare an Annual Environmental Report (AER) for the Yannarie Solar Project. The AER will report on the environmental commitments, including monitoring results, management responses and environmental performance.

A Tripartite Stakeholder Liaison Group (TSLG) has been established and will continue to provide a public forum for transparent environmental management.

The TSLG will be provided with all monitoring data resulting from management commitments as well as helping to develop and implement the respective community based programs.

Meetings of the TSLG will be open to the public and the group will include representatives from:

- community environmental organisations
- local Government
- Chamber of Commerce and Industry
- recreational fishing sector
- commercial fishing sector
- tourism
- Straits Resources.

2.6 REVIEW ON MANAGEMENT PLANS AND UPDATING ENVIRONMENTAL MANANGMENT SYSTEMS

The Environmental Management Plan and component environmental management plans will be periodically reviewed and revised in line with the adaptation of procedures to achieve objectives consistent with emerging situations and changing knowledge. The review and update process will be undertaken in consultation with key stakeholders and the TSLG.

Minor changes to operational practices will be made from time to time necessitating changes to the EMP. The EMP will also require periodic amendments to account for changes in statutory environmental requirements and policies, operational experience, and initiatives for environmental management and improvement.

The CEMS will be continually reviewed and revised during construction, based on feedback from audits and from day-to-day operations. Reviewing of the CEMS will determine whether the system is functioning adequately, which areas of the system need improvement and any alternative procedures that may be more effective than those currently in place.

In order to provide effective feedback, the CEMS should ensure that:

- regular inspections of key areas highlighted in the Construction Environmental Management Plan are undertaken
- environmental incidents (e.g. major chemical spills, unintended disturbance to vegetation) are reported and rectified.

Through periodic review of the CEMS, continuous improvements can be made and the potential for environmental issues can be minimised.

Chapter 2

Environmental Management Plans

Chapter 2 Environmental Management Plans

1 TERRESTRIAL VEGETATION MANAGEMENT PLAN

1.1 CONTEXT AND SCOPE

The implementation of the proposal will be managed to avoid, minimise, rectify, reduce and offset impacts on vegetation and flora, wherever practicable. This Terrestrial Vegetation Management Plan (TVMP) outlines management actions for vegetation clearing, a monitoring, review and reporting program and a contingency plan should vegetation monitoring indicate unexpected impacts.

Clearing activities for the project fall into three main components:

- access track location and management (pre-construction phase)
- infrastructure clearing envelopes (construction phase)
- operational activities (ongoing works).

Benthic primary producer habitat vegetation (mangroves) is addressed in the Marine Management Plan.

1.2 OBJECTIVES

The EPA normally applies the following objective to the assessment of proposals that may affect vegetation and flora. The objective considered relevant to this assessment is:

- *To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.*

In addition the EPA prescribes an overriding objective addressing biodiversity, as follows:

- *To maintain biological diversity where that represents the different plants, animals and micro-organisms, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

The objectives of the Terrestrial Vegetation Management Plan are to:

- To protect significant flora and vegetation communities, consistent with the provisions of the *Wildlife Conservation Act 1950.*
- To minimise the disturbance to terrestrial vegetation.
- To monitor the impact of the proposal on vegetation and flora.

Under the above Act any disturbance or destruction of native flora without prior approval or specific exemptions is an offence.

1.3 POTENTIAL IMPACTS

Key activities or aspects of the proposal that may potentially affect terrestrial vegetation and flora include:

- **site preparation** will involve removal or disturbance of vegetation, with associated primary and secondary effects. For example, removal of vegetation has the potential to:
  - disturb significant flora species
  - change the abundance, species diversity, geographic distribution and productivity of vegetation communities
  - compromise the conservation values through impacts on regionally significant flora and vegetation communities
  - introduce weed species
- **construction** of the ponds and associated infrastructure could increase the risk of spread of weeds and weed-seeds (e.g. Buffel grass), as well as increase the potential for dust generation
- **hydrological changes** (e.g. flooding of the saltfield) could lead to the loss of vegetation in certain soil types.

1.4 ENVIRONMENTAL OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

Environmental targets and key performance indicators have been set to meet the objectives of the Terrestrial Vegetation Management Plan (Table 2-1).

Table 2-1 Environmental targets and performance indicators for terrestrial vegetation

Objective	Preliminary target	Performance indicators
To protect significant flora and vegetation communities, consistent with the provisions of the *Wildlife Conservation Act 1950*.	All significant flora or vegetation communities identified and mapped. Significant flora and communities to be avoided through project design, if possible. If disturbance can not be avoided, no disturbance will be undertaken until the DEC has been consulted and the appropriate licences acquired.	Flora and vegetation surveys Construction plan Correspondence with the DEC and licence
To minimise the disturbance to terrestrial vegetation.	No clearing of vegetation outside that defined in the construction plan.	Site inspections to compare area and location of clearing that has been undertaken to that defined in the construction plan Incident report register
	No long-term change in vegetation composition within any vegetation unit.	Monitoring surveys of native and exotic flora species
To monitor the impact of the proposal on vegetation and flora.	A specific monitoring program in place to enable changes in vegetation and flora to be identified and quantified	Monitoring program implemented as per this plan

The Preliminary targets will be finalised in the detailed Terrestrial Vegetation Management Plan.

1.5 MANAGEMENT ACTIONS

1.5.1 Baseline surveys

Flora and vegetation communities will be progressively surveyed within the project area prior to construction of salt field components. Emphasis in the first instance will be placed on surveying the southern portion of the project area which has not yet been surveyed. Surveys may also be undertaken on mainland remnants subject to possible saline water intrusion and at sites potentially at risk from inundation due to flooding, to provide reference sites and data.

These surveys will be undertaken in accordance with *Guidance Statement 51: Terrestrial flora and vegetation surveys for Environmental Impact Assessment in Western Australia*.

1.5.2 Vegetation clearing

During the project design phase, the majority of the operating area has been restricted to the barren salt flats, thus limiting vegetation clearing. The following actions will be implemented with respect to the clearing of vegetation:

1. Manage operations to avoid, minimise, rectify, reduce and offset impacts to Declared Rare and Priority flora.
2. Design and construct access tracks to minimise vegetation clearing, and differentiate between temporary access tracks (required for < 1 month) and longer-term access tracks.
3. Vegetation and topsoil cleared for longer-term access tracks will be removed and windrowed or stockpiled for use in rehabilitation activities.
4. Undertake clearing for temporary tracks using a scrub roller or lifted blade technique to minimise disturbance to topsoil.
5. Clearing zones will be shown on construction plans and, prior to disturbance, marked in the field using pegs or flagging.
6. A detailed clearing procedure will be developed to minimise clearing of native vegetation.
7. A vegetation clearing permit (Appendix 1) shall be completed and approved by the Project Manager prior to activities that will, or have the potential to, impact upon native vegetation and topsoil within the project area. The permit will include hold points that require further approval by a qualified Environmental Officer and sign off by the Project Manager.
8. Avoid off-road vehicle movements outside designated clearing areas and site access tracks.
9. Resurvey cleared areas to confirm that clearing has been undertaken within the designated footprint.
10. Record vegetation survey results and store for a period of not less than 10 years.
11. Identify and record areas of over-clearing and report to the relevant statutory authorities.
12. Employees and contractors of Straits will be educated on the conservation values of flora and vegetation.
13. No cleared vegetation will be burnt.

1.5.3 Weeds

The following actions will be implemented with respect to the distribution and spread of weeds:

1. Weed mapping will be completed in areas where soil is to be disturbed to differentiate between clean and weedy soil.
2. Soil removed for construction purposes, that is identified as a potential source of weeds, will be stored separately to clean soil.
3. Wash down area to be established at the entry point to the project area for vehicle and equipment inspection and wash down if necessary.
4. Wash down area to include water containment facilities to prevent the spread of weed propagules or plant material. Water to be reused where practicable.
5. All vehicles, plant and equipment to be cleaned down prior to being brought to site such that they are free of all dirt, mud and plant material.
6. All plant and vehicles are to be inspected by a designated project team member to confirm that they are clean prior to entering the site.
7. Vehicles or mobile equipment that fails to pass inspection will be washed down and re-inspected. Vehicles and mobile equipment will not be permitted to enter the site until they have passed inspection.
8. Periodic inspections of earthworks and disturbed areas will be carried out by site environmental personnel to identify any new infestations of weeds in works areas. Weeds known to occur in the area (**Cenchrus ciliaris* and **Prosopsis sp.*) are to be the main focus. Specialist advice will be sought in the event that an unidentified weed species is suspected.
9. Any new infestations are to be included on a weed register and will be subject to routine weed control activities, which will include manual removal of plants and topsoil and chemical spraying.
10. Implementation of weed control measures in areas of weed infestations.
11. A record of all inspections and control actions will be maintained.

1.5.4 Rehabilitation

Operation of the salt field will involve temporary and long-term land disturbance. The rehabilitation descriptions outlined in this section relate to temporary land disturbance, which includes construction camps, lay-down areas and some access tracks. Long-term disturbances, e.g. the salt pan and areas where infrastructure required for the life of the project shall be located, will be considered at the closure planning phase.

The following actions will be implemented with respect to rehabilitation of disturbed areas no longer needed for the operations:

1. Cleared native vegetation will be chipped and retained on site for use in rehabilitation.
2. Rehabilitation will utilise seed collected from local provenance areas.
3. Minimise the time between clearing for infrastructure and rehabilitation of the areas to prevent erosion and weed spread and facilitate early establishment of native vegetation cover.
4. Prepare and implement a rehabilitation plan that complies with current best practice for rehabilitation.

The objective of rehabilitation will be to *'establish a self-sustaining ecosystem with species composition and ecological function compatible with the undisturbed surroundings.'* Preliminary completion criteria for rehabilitated areas, in accordance with *Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems*, include:

1. Landforms re-established to be suitable for the agreed post-disturbance land use, this includes being safe and stable, without inputs.
2. No pollution within the area.
3. Soil structure and function sufficient to support re-established vegetation type.
4. All native flora species used for rehabilitation will be local provenance.
5. All 'Declared Plants', as stipulated under the *Agriculture and Related Resources Protection Act 1976*, to be eradicated where possible, or contained within the disturbance area.
6. Provision of fauna habitat.

1.6 MONITORING, REVIEW AND REPORTING

The key monitoring requirements are presented in Table 2-2.

Table 2-2 Key monitoring requirements for vegetation and flora

Objective	Parameter	Frequency/Duration	Location	Purpose
To protect significant flora and vegetation communities, consistent with the provisions of the *Wildlife Conservation Act 1950*.	Significant flora and vegetation	Annually	Within project area	To ensure any significant flora and vegetation communities are protected, consistent with the provisions of the *Wildlife Conservation Act 1950*
To minimise the disturbance to terrestrial vegetation.	Native vegetation clearing	During construction	Within project area	To reconcile all clearing activities against approved clearing limits
	Change in vegetation composition (including abundance, distribution, condition and % foliage cover)	Every 3 years using suitable imagery analysis (e.g. NDVI or similar)	Adjacent to and within the project area	To determine if operations have any impact on native vegetation and flora not reserved for clearing
		Annually	In areas that are inundated	To determine inundation affects on vegetation
		Annually	In mainland remnants located throughout the proposed pond areas	To determine if saline water intrusion in low-lying areas on mainland remnants affects vegetation communities
		Annually	Within coastal locations where dewatering is occurring	To determine the affect of dewatering on vegetation in coastal locations
		Twice annually	Within disturbance area	To determine whether weed abundance and distribution has increased as a result of the project.
		Annually	In rehabilitation areas within the project area	To determine rehabilitation success

Monitoring data will be reviewed annually and results will be summarised within the AER.

1.7 CONTINGENCIES

In the event that monitoring shows that clearing/disturbance of vegetation for construction activities have breached or may be in breach of requirements and may result in detrimental effects on terrestrial flora, the following contingency actions will be implemented:

- immediate cessation of activity
- notification of appropriate regulatory agencies
- review of vegetation clearing control procedures, and/or weed control procedures
- undertake rehabilitation of project related impacts to the satisfaction of the EPA
- greater education of the workforce.

Triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in a TVMP that will be prepared prior to the commencement of any construction activity. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

2 TERRESTRIAL FAUNA MANAGEMENT PLAN

2.1 CONTEXT AND SCOPE

The Terrestrial Fauna Management Plan (TFMP) applies to all ground disturbing activities associated with the construction and operational phase of the project, which may have the potential to impact native terrestrial fauna.

2.2 OBJECTIVES

The EPA objectives considered relevant to this assessment is:

- *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.*
- *To protect species listed under the EPBC Act 1999, and Schedule and Priority Fauna consistent with the Wildlife Conservation Act 1950.*

The objectives of the Terrestrial Fauna Management Plan are:

- To protect fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*
- To reduce the disturbance to fauna habitat.
- To monitor the impact of the proposal on fauna.

2.3 POTENTIAL IMPACTS

Activities or aspects of the proposal that may potentially affect terrestrial fauna include:

- **site preparation** will involve removal or disturbance of some fauna habitat from areas proposed for the Hope Point barge harbour and infrastructure associated with buildings, site offices and the construction camp
- **vehicle and equipment movement** within the project area and roads could result in occasional fauna deaths
- **noise emissions** from the operations within the barge harbour and associated infrastructure may make habitat close to the operations unsuitable for fauna foraging and/or habitat.

2.4 ENVIRONMENTAL OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

Environmental targets and key performance indicators have been set to meet the objectives of the Terrestrial Fauna Management Plan (Table 2-3).

Table 2-3 Environmental targets and performance indicators for terrestrial fauna

Objective	Preliminary target	Performance indicator
To protect fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*	All significant fauna identified and their habitat mapped. Significant fauna habitat to be avoided through project design, if possible. If habitat disturbance can not be avoided, no disturbance will be undertaken until the DEC has been consulted.	Fauna surveys Construction plan Correspondence with the DEC
To reduce the disturbance to fauna habitat	No clearing of vegetation outside that defined in the construction plan.	Site inspections to compare area and location of clearing that has been undertaken to that defined in the construction plan Incident report register
	No long-term change in vegetation composition within any habitat type.	Monitoring surveys of native and exotic flora species
To monitor the impact of the proposal on fauna.	A specific monitoring program in place to enable changes in fauna to be identified and quantified	Monitoring program implemented as per this plan

The Preliminary targets will be finalised in the detailed Terrestrial Fauna Management Plan to be prepared in consultation with DEC as part of the environmental commitments.

2.5 MANAGEMENT ACTIONS

2.5.1 Baseline surveys

The following actions will be implemented with respect to baseline surveys of terrestrial fauna:

1. Terrestrial fauna will be surveyed within the project area prior to construction, and reference sites will be established.
2. Identification of significant habitat areas to assist in the retention of native terrestrial fauna. Any confirmed significant habitat will be documented, quarantined from any potential disturbance and relevant data provided to the DEC. Management response to be developed in consultation with the DEC as part of the Terrestrial Fauna Management Plan.
3. Conduct further seasonal terrestrial fauna surveys external to proposed mining areas to more accurately document the occurrence of native terrestrial fauna species and determine occurrence of transient species that may be affected by habitat disturbance and/or loss.

Terrestrial fauna surveys will be undertaken in accordance with *Guidance Statement No. 56: Terrestrial fauna surveys for Environmental Impact Assessment in Western Australia*.

2.5.2 Loss of habitat

As part of the design phase, options for maintaining native vegetation (including wildlife corridors and linkages) were investigated thus minimising vegetation clearing to areas outside of the salt flats. The following actions will be implemented with respect to loss of potential terrestrial fauna habitat:

1. Retention of the significant majority of vegetated areas within the project area.
2. Utilising the barren salt flat for bunds and evaporator ponds as far as practicable.

3. Minimising clearing of vegetation within the project area, through actions described in the Terrestrial Vegetation Management Plan (Section 1 Chapter 2).
4. Workforce environmental education programs and training regarding the management of native fauna and fauna habitat. Measures specific to the protection of native fauna habitat include prohibiting burning within the project area at all times.
5. Rehabilitation of disturbed areas will be commenced within 12 months or next appropriate season, with re-creation of fauna habitats to encourage fauna re-colonisation (refer to Terrestrial Vegetation Management Plan, Section 1, Chapter 2).

2.5.3 Impact from vehicle and equipment movement

The following actions will be implemented with respect to potential impacts to terrestrial fauna from vehicle and equipment movement onsite:

1. Workforce environmental education programs and training (e.g. information brochures and inductions addressing fauna species of conservation significance). Measures specific to the protection of native fauna from vehicle and equipment movement include minimising driving at dawn and dusk wherever possible.
2. Reduce noise from loading operations as far as practicable, during the breeding and nesting season of shore birds and waders.
3. Enforcement of vehicle site speed limits (these are to be developed in consultation with the DEC).
4. Recording any road kill of native fauna that arises due to impact with traffic associated with the project.
5. Review records of road kill frequency periodically to assess the effectiveness of environmental awareness training and the general awareness in relation to this issue.

2.5.4 Noise

The following actions will be implemented with respect to potential impacts to terrestrial fauna from noise:

1. Workforce environmental inductions to include noise regulations requirements.
2. Compliance of all vehicles and salt field infrastructure with noise regulations.
3. Reduce noise from loading operations, as far as practicable, during the breeding and nesting season of shore birds and waders.
4. Incorporation of bunds where required to reduce noise in the vicinity of sensitive fauna habitat.

2.5.5 Feral fauna

The following actions will be implemented with respect to potential impacts to terrestrial fauna from feral fauna:

1. Develop and implement a collaborative feral animal program, which integrates feral cat and fox control measures, in conjunction with DEC.
2. Workforce environmental education programs and training regarding the management of native fauna. Measures specific to the protection of native fauna from feral fauna include:
    - prohibiting firearms, traps, pets and feral fauna from the project area
    - implementing waste management procedures (to deter feral fauna).

2.6 MONITORING, REVIEW AND REPORTING

The key monitoring requirements for terrestrial fauna are presented in Table 2-4.

Table 2-4 Key monitoring requirements for terrestrial fauna

Objective	Parameter	Frequency/ Duration	Location	Purpose
To protect fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Significant fauna	Annually	Within project area	To ensure any significant fauna are protected, consistent with the provisions of the *Wildlife Conservation Act 1950*
To reduce the disturbance to fauna habitat.	Significant habitat (abundance [especially critical weight range mammals for significant fauna] and distribution of fauna species)	Annually	Within the project area	To determine habitat associations of fauna and any effects on fauna from fragmentation of habitat
	Vegetation clearing	During construction	Within project area	To reconcile all clearing activities against approved clearing limits
	Changes to habitat that alter the abundance and distribution of fauna	Annually	Adjacent to and within the project area	To determine if operations have any impact on native terrestrial fauna populations
		Annually	Rehabilitated areas within the project area	To measure fauna re-colonisation in rehabilitation areas
		Annually	Adjacent to and within the project area	To determine if feral animals are affecting native fauna species

Monitoring data will be reviewed annually and the results will be summarised within the AER.

2.7 CONTINGENCIES

In the event that monitoring of native terrestrial fauna shows that disturbance of habitat or significant fauna has occurred outside of the clearing zones designated on the construction plans, the following contingency actions will be implemented:

- notification of appropriate regulatory agencies
- rehabilitation of cleared areas outside the designated clearing zones depicted on construction plans
- re-emphasise through workforce inductions sensitive fauna habitat areas and work procedures to minimise impacts to fauna (e.g. minimise driving at dawn and dusk, appropriate waste control to deter feral animals).

Triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in a TFMP that will be prepared prior to the commencement of any construction activity. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

3 MARINE MANAGEMENT PLAN

3.1 CONTEXT AND SCOPE

The Yannarie Solar Project is proposed to be located on the eastern coast of Exmouth Gulf. This Marine Management Plan addresses the environmental issues associated with the project including potential affects to marine water and sediment quality, benthic primary producer habitat and ecosystem integrity and marine fauna.

3.2 OBJECTIVES

The EPA objectives relevant to the Marine Management Plan include:

Water and sediment quality

- *Maintain or improve marine water and sediment quality in compliance with sediment and water quality guidelines documented in Australian and New Zealand Water Quality Guidelines (ANZECC 2000).*

Benthic primary producer habitat

- *To maintain the integrity, ecological functions and environmental values associated with Exmouth Gulf, the intertidal zone and adjacent hinterland.*
- *To maintain the abundance, diversity, geographic distribution and productivity of mangroves and mangrove associations, through no loss of mangrove associations including algal mats.*
- *To maintain the integrity, ecological functions and environmental values of listed wetlands.*
- *To ensure that appropriate consideration is given to cumulative impacts on Exmouth Gulf.*

Marine fauna

- *To maintain the abundance, species diversity and geographic distribution of marine fauna.*
- *To ensure that any impacts on locally significant marine communities are avoided, minimised and/or mitigated.*
- *To protect EPBC Act 1999 listed threatened or migratory species.*
- *To protect Specially Protected (Threatened) Fauna consistent with the provisions of the Wildlife Conservation Act 1950.*

The objectives of the Marine Management Plan are:

- To protect significant marine fauna consistent with the provisions of the *Wildlife Conservation Act 1950* and the EPBC Act.
- To minimise the disturbance to benthic primary producer habitat and marine fauna.
- To monitor the impact of the proposal on benthic primary producer habitat.

3.3 POTENTIAL IMPACTS

Key activities or aspects of the proposal that may potentially affect benthic primary producer habitat and fauna and require application management controls include:

- **storage and solar concentration of bitterns** has the potential to affect water quality through seepage into algal mat and mangrove communities and in the unlikely event that failure of bunds occurs
- **dredging** can given rise to turbidity resulting in shading or smothering of benthic primary producers thereby affecting water quality. Dredging will also lead to the physical removal or modification of habitat
- **storage of hydrocarbons or fuels** with the risk of spills resulting in contamination as a result of ongoing operations can potentially affect water quality
- **ship and barge movements** may give rise to turbidity that affect water quality and smothering of marine habitat, underwater noise emissions, collisions with marine fauna, loss of anti-foulants and introduction of non-indigenous marine species (NIMS)
- **site preparation** (including construction of ponds, pump stations, infrastructure corridor and seawater canals) leading to the physical removal/clearing of habitats (e.g. seagrass, algae, sponges, corals, mangroves and algal mat)
- **light spill** primarily associated with barge harbour infrastructure may potentially disturb some fauna species
- **location of project infrastructure and seawater pumping of water into ponds** could lead to hydrodynamic changes resulting in a reduction in tidal flushing in creeks and in extent of inundation during high tides and entrainment or entrapment of marine fauna.

3.4 TARGETS AND PERFORMANCE INDICATORS

Specific targets and performance indicators for the marine environment will be developed in consultation with DEC as part of the detailed Marine Management Plan and Dredging Management Plan that will be prepared prior to construction. The proponent has committed to the preparation of these plans.

3.5 MANAGEMENT ACTIONS

3.5.1 Maintenance of bund integrity

Bitterns concentration and crystalliser ponds are designed to withstand extreme events (including cyclones) and to date, gross failure of similar structures at other salt fields has not occurred when correctly engineered and constructed. In extreme events ponds may be overtopped but are not expected to fail.

The following management actions will be implemented to maintain the integrity of crystallizer and evaporator ponds:

1. Develop a bund wall inspection checklist.
2. Regular inspection of bund walls, using the bund wall inspection checklist, to detect defects, erosion and seepage.
3. If inspection detects defects, maintenance will be carried out to fix the problem and ensure bund integrity.

3.5.2 Baseline surveys

The following baseline survey program will be developed in consultation with DEC to the satisfaction of the EPA. The surveys will be completed prior to the commencement of dredging/marine excavation and the results reported to the DEC. The baseline survey results will be used to determine suitable reference sites and targets in consultation with DEC and to the satisfaction of the EPA. The following actions will implemented with respect to baseline surveys of the marine environment:

Marine water and sediment quality

1. Establish baseline turbidity and suspended sediment concentrations, based on a baseline sampling program considering the predictions from the modelling and the location of sensitive habitat and aquaculture leases.

Benthic primary producer habitat and ecosystem integrity

1. Conduct transect surveys of mangroves and algal mats, recording condition and distribution particularly in the areas where potential hydrological changes from infrastructure crossing points could affect these communities.
2. Conduct baseline surveys to determine baseline sediment and nutrient flows from Naughton Creek and Dean's Creek into the benthic primary producer habitat and the Gulf.
3. Undertake monitoring of offshore benthic primary producer habitat to determine health of non-ephemeral primary producers, by establishing habitat health and water quality monitoring sites in habitats found to be most at risk and at suitable reference sites.
4. Undertake an initial shoreline profile at Hope Point as a baseline to establish trends or changes in creek morphology due to the operation of the seawater pumps.
5. Undertake bathymetric surveys in order to assess changes in localised and creek scale morphology/bathymetry due to change in tidal flows and velocities at pump stations. Surveys will be conducted at Naughton Creek, North Creek, Dean's Creek and Scott's Creek.

Marine fauna

1. Undertake a baseline survey to establish the status of Non-indigenous Marine Species (NIMS) in the Exmouth marina, at the proposed salt loading anchorage sites and at Hope Point. This survey will be in accordance with guidelines developed by the Centre for Research on Introduced Marine Pests (CRIMO).
2. Conduct a baseline survey of biota (including species present and the stages of their life cycle) in Naughton Creek, North Creek, Dean's Creek and Scott's Creek to determine impacts of seawater pumps.
3. Evaluation of available methods for management of entrained fish in consultation with the Department of Fisheries.
4. Develop mitigation measures during detailed design. The techniques may include:
    - targeted removal
    - screening the connections between ponds
    - exploitation of the fish resources within the concentrator pond
    - controlled management use of the ponds by recreational fishermen.

3.5.3 Marine water and sediment quality

Dredging management

The following management actions will be implemented with respect to dredging:

1. Sampling of dredge spoil before disposal to determine the presence of acid sulphate soils.
2. Restrict dredging to between 30 March and 30 October to coincide with the period of seagrass dormancy and when light requirements of benthic primary producers are naturally at a minimum.
3. Reassess the continuation of dredging if wind speed and wave height exceed the operational parameters of the dredge.
4. Ensure the type and size of dredge head used matches the performance and capacity of the suction pump, to minimise potential sediment plumes.
5. Develop water quality criteria for protecting sensitive areas identified during baseline surveys.
6. Dredge spoil will be disposed of on-shore, which will significantly reduce the impact on marine fauna and habitat arising from turbidity. Overflow from spoil disposal area will be stored to reduce turbidity to below mean background levels before discharge to the marine environment.
7. A Dredging Management Plan will be prepared in consultation with the DEC to the satisfaction of the EPA prior to the commencement of any dredging/marine excavation activity. The Plan will include the location of sampling sites (within sediment plume and reference sites), spoil disposal, targets, performance indicators, triggers and contingencies.

Shipping, barging and navigation

The following management actions will be implemented with respect to ship and barge movements:

1. Requiring compulsory piloting of salt transport ships within the Gulf.
2. Prepare and implement piloting procedures.
3. Develop designated shipping routes to be used by salt transport ships.
4. Develop designated anchorage areas to be used by salt transport ships.
5. Restrict the maximum speed of salt transport ships of 10 knots within the Gulf.

The following management actions will be implemented with respect to barging operations:

1. At the commencement of barging operations, aerial photographs of barging operations will be taken to quantify the extent of any turbidity plumes.
2. Light and turbidity will be 'logged' above the closest sensitive habitat adjacent to the channel and at a reference site.
3. Light, suspended sediment and turbidity measurements will be made in transects through plumes generated by barge movements. The number of measurements made will be dependent on the degree of risk posed (i.e. the extent and intensity of any plumes) and the amount of data required to quantify the extent and intensity of the plume caused by barge movements.
4. The program will run for one year and stop after that point unless the results have demonstrated that there is a risk of impacts occurring.
5. If this is the case, management measures will be assessed and introduced and the program will continue.

Spill management

The following management actions will be implemented with respect to spills (including oil, fuel and hazardous materials):

1. Define shipping routes and navigation procedures, speed restrictions and designated anchorage sites.
2. Record and map areas of exceptional environmental sensitivity information.
3. Prepare and implement storage and/or disposal procedures for hydrocarbons and hazardous materials.
4. Store and maintain spill recovery and cleanup equipment at Hope Point.
5. Liaise with State Emergency Services and other groups in respect to regional emergency spill response planning.
6. Develop and implement an Oil Spill Contingency Plan, which will include the following:
    - safety information and safety priorities (e.g. personnel safety, fire prevention, eliminating the source of the oil spill)
    - environmental sensitivity information and priority protection areas (e.g. meteorological and oceanographic conditions, marine and coastal habitats and fauna, ecological processes and human uses)
    - oil spill movement/trajectory and fate information (e.g. oil characteristics, predicted trajectory paths and breaching times)
    - response, clean-up and rehabilitation options and strategies (e.g. offshore surveillance and monitoring, booming, skimming and recovery, shoreline flushing and washing, application of nutrients and/or oil degrading bacteria on shorelines, environmental monitoring requirements)
    - disposal strategies (e.g. authorised land disposal, oil recovery and recycling, incineration)
    - actions required to be undertaken in the event of an oil spill (e.g. stopping, reporting and assessing the spill, organising surveillance and spill management measures)
    - roles, responsibilities and authorities for ensuring actions are undertaken in the event of an oil spill
    - inventory lists of facilities, equipment and materials available for use in the event of an oil spill, including spill clean up kits to deal with spills on the dredger and a suitably sized oil spill boom for containment of oil spills on water (e.g. aircraft, vessels, dispersants, booms, skimmers, absorbent materials, storage tanks, oil spill waste disposal sites)
    - resources and external emergency services (e.g. telephone and radio communications systems, initiating callout of internal and external personnel and resources, contact lists for personnel, external emergency services, resources and equipment suppliers, Government and specialist assistance groups).
7. Workforce environmental education and training regarding spill management procedures described in the Oil Spill Contingency Plan.

Marine water and sediment quality monitoring

The following management actions will be implemented with respect to monitoring marine water and sediment quality:

1. Collect water and sediment samples from sites at risk of hydrocarbon pollution and analyse for Polycyclic Aromatic Hydrocarbon (PAH) compounds and total petroleum hydrocarbons as part of a regular water and sediment quality program (frequency to be established).
2. Collect sediment samples from sites (numbers and locations to be determined) at risk of pollution and analyse for metals, organotins, particle size distribution (PSD), total petroleum hydrocarbons and total organic carbon (TOC) as part of a regular water and sediment quality program (frequency to be established).
3. Include any areas where drainage from site may reach the marine environment in the regular sediment quality monitoring program, with sediment samples analysed for PAHs, metals, organotins, PSD and TOC.

3.5.4 Benthic primary producer habitat and ecosystem integrity

Mangroves and algal mats

The following management actions will be implemented with respect to mangroves and algal mats:

1. Implement mangrove vegetation clearing procedure containing definitions of clearing limits, surveying these limits in the field and erecting bunting or other clear boundary markers on-site.
2. Require all clearing of any mangrove or algal mat to be authorised by the Operations Manager prior to proceeding.
3. Include in site environmental inductions the significance of the mangroves and algal mats, hydrocarbon management and clearing controls.
4. Include management procedures and actions in contractual specifications in construction and post-construction environmental auditing.

Coastal processes

Prepare and implement a monitoring program to determine the affects of the proposal on Hope Point and surrounding creeks (refer section 3.6).

3.5.5 Marine fauna

Underwater noise

The following management actions will be implemented with respect to underwater noise during the period of peak whale cow/calf activity in the Gulf (nominally 4 weeks between 20 September and 17 October). The start of the peak whale period may vary naturally by 2-3 weeks each year and will be subject to consultation with the Centre for Whale Research (CWR). Mitigation measures for vessels operating within the Gulf will include:

1. Restricting the speed of all vessels operating in Exmouth Gulf as low as practicable and always less than 10 knots.

2. Requiring all tug Masters to, as far as practicable:
    - keep manoeuvring operations as gentle as possible
    - avoid driving their vessels main propellers beyond cavitation inception
    - reduce the use of bow thrusters
    - maintain a watch for sleeping or resting cow/calf pairs and maintain a 100 m approach limit.
3. Develop and implement maintenance procedures and maintenance performance standards for all vessels directly associated with Yannarie Solar operations (service vessels, tugs and barges) to ensure clean hulls and propellers, undamaged propellers, good mechanical condition of gearboxes and engines.

Vessel avoidance

The following management actions will be implemented with respect to minimising the potential for vessel avoidance of marine fauna (including dugongs):

1. Reduce as far as practicable shipping movements in the Gulf during the 4 week period of peak whale cow/calf activity, notionally between 20 September and 17 October. The commencement of the 4 week period of cow/calf activity will be subject to consultation with the CWR.
2. Restrict the speed of all vessels operating in Exmouth Gulf as low as practicable and always less than 10 knots.
3. Establish and use designated routes and anchorage areas for salt transport ships and barge movements.
4. Maintain a watch for sleeping or resting cow/calf pairs and maintain a 100 m approach limit.
5. Every bulk carrier in the Gulf that is associated with the Yannarie Solar Project will be under the control of a Straits engaged pilot who will board the vessel prior to it entering the Gulf.
6. During the peak whale cow/calf period of activity, Straits will avoid completely the medium density area (75% P Contour plot) identified by the CWR following an interpretation of the results from the aerial surveys commissioned for the project.
7. During the peak whale cow/calf period of activity, Straits will apply a buffer of 1.5 km along the medium density area contour and all ship loading activities (salt barges, tugs and bulk carriers) will be kept outside of this buffered zone.
8. Straits will monitor the presence of humpback whales along designated shipping and barge routes and anchorages during the peak whale cow/calf period of activity and inform ship and barge Masters of the presence of humpback whales in the vicinity of designated routes and anchorages.
9. Prepare and implement avoidance procedures for whale strikes in the Gulf, in consultation with the CWR.
10. Straits will implement an initial 5-year Whale Interaction Research Program in consultation with the CWR. The Whale Interaction Research Program will include, but not be limited to:
    - baseline monitoring (including satellite tagging) of cow/calf distribution and movements prior to first export schedule
    - monitoring (including satellite tagging) of cow/calf distribution and movements in the Gulf for the first two years of export operations

- development of criteria to assess and evaluate risk of displacement of whales from the Exmouth Gulf
- review of all whale monitoring data after each period of cow/calf activity in consultation with CWR. Results of the review of monitoring data to inform any necessary changes to the Marine Management Plan
- population growth rate assessment with calculation of population maximum size and prediction of population 'tail-off'
- determine importance and significance of 'mud-rolling' areas within the Gulf to the population
- whale monitoring data and assessment of displacement risk to inform the proposed major environmental review of the proposal prior to the commencement of Stages 3 and 4.

Anti-foulants

The following management actions will be implemented with respect to anti-foulants:

1. Conduct baseline survey anti-foulants levels in the barge harbour and surrounds.
2. Vessels owned by the proponent will be anti-fouled with an environmentally-friendly commercially available anti-foulant, prior to commissioning.
3. Ban the use of tributyltin oxide (TBT) on all Straits owned and leased vessels.
4. Require contractors to use current best practise anti-fouling systems.

Non-indigenous marine species

The following management actions will be implemented with respect to NIMS:

1. Require salt transport ships from foreign ports to comply with the Australian Quarantine and Inspection Service (AQIS) requirements/procedures for ballast water exchange. AQIS requirements include:
    - vessels must forward a Quarantine Pre-Arrival Report (QPAR) to AQIS for assessment no less than 24 hours prior to arrival
    - vessels will allow inspection by AQIS on request and comply with all AQIS directions
    - vessels will only enter the Exmouth Gulf after receiving clearance from AQIS.
2. Minimise, as far as practicable, the time any ship is anchored in the Gulf.
3. Require ships unable to load immediately will be required to anchor outside the Gulf.
4. Monitor the performance of export ships and captains via the use of 'Ship Right', an international shipping accreditation program.
5. Prepare and implement procedures for Straits support vessels that reduce, as far as practicable, mooring time near ships and other marine craft.
6. Prepare and implement an inspection and maintenance procedure for all Strait's barges and tugs (whether owned, leased or contracted) which will include regular inspections for NIMS and cleaned up in accordance with ANZECC (2000) Guidelines.
7. In the event that potential NIMS are found, immediately contact the Marine Biosecurity Unit of the WA Department of Fisheries.

Light spill

The lighting system for the project will be designed on the assumption that the area is a turtle nesting area, even though there is no evidence of nesting sites at either pumping station sites or at Hope Point. Other marine animals may also be attracted by lights.

The following management actions will be implemented with respect to lighting:

1. Design and implement a lighting system of Strait's operational areas which will:
    - reduce as far as practicable lighting visible from coastal beaches
    - reduce light spill to the shore through shielding, positioning, directional lighting and use of timing switches
    - use non-attracting lights, such as low-pressure sodium bulbs, in all coastal lighting (other than to meet regulatory requirements—marine and aircraft navigation lighting).

Seawater pumping

The following management actions will be implemented with respect to entrapment and entrainment:

Entrapment

1. Design and install screens on pump stations to reduce entrapment of marine macrofauna.

Entrainment

1. Investigate and implement techniques to reduce or manage entrainment of marine fauna including:
    - internal bunding in the initial concentrator pond
    - targeted removal of entrained fauna
    - screening connections between concentrator ponds
    - commercial exploitation of the marine fauna resources entrained within the concentrator pond
    - controlled management use of the ponds by recreational fishermen.

3.5.6 Research

1. Prepare and implement an Exmouth Gulf Research Project to enhance knowledge of marine environment of the Gulf.
2. The Exmouth Gulf Research project will include the following:
    - a research project (PhD) to investigate the linkages between terrestrial and coastal habitats to improve the management strategies necessary for sustaining the productivity of the coastal zone. The objective of the investigation will provide a clear understanding of the relationship between the supra-tidal salt flats, algal mats, mangroves and secondary consumers such as crabs, fish and prawns
    - a 2-year program ($50,000 per year) for a proposed Dugong survey of the Gulf. This project will be developed in consultation with DEC and its objective will be to investigate the link between Dugong survey results and habitat use

- a research project (PhD) to investigate the linkages between benthic habitat and the dugong survey results arising from the Straits funded Dugong survey of the Gulf
- a community turtle monitoring program (up to $20,000 per year) on the eastern side of the Gulf. The community turtle monitoring program will be developed and finalised in consultation with the Stakeholder Liaison Group
- a community seagrass monitoring program (up to $15,000 per year) for the eastern part of Exmouth Gulf. This program will be developed in consultation with the Stakeholder Liaison Group
- a Whale Interaction Research Program.

3.6 MONITORING, REVIEW AND REPORTING

The key components of marine monitoring program are summarised below and presented in Table 2-5:

1. Marine water quality (particularly turbidity and suspended and deposited sediments).
2. Mangroves and algal mat condition and distribution.
3. Transmission pathways (particularly for sediment and nutrients) from creeks to the benthic primary producer habitat and Gulf.
4. Shoreline changes and alterations to creek morphology/bathymetry in four creeks (two controls). Any changes in cross-sectional area will be examined in terms of whether it is unique to the creeks with the pumping stations or whether any such changes are occurring in unaffected creeks.
5. TBT levels in sediment.
6. Abundance/distribution of marine flora and fauna.
7. Occurrence of NIMS on vessels, hard structures and to assess potential introduction in accordance with guidelines developed by the CRIMP. A variety of methods will be used comprising settlement plates, 'Christmas tree' rope, spat bags, plankton net tows and scrapings from hard structures.
8. Fauna in creeks affected by pumping stations and within the concentrator/evaporation ponds.

Table 2-5 Key monitoring requirements for marine factors

Purpose	Parameter	Frequency
Marine water and sediment quality		
Dredging		
To determine the impact of dredging on water quality and thus indirectly the inhabiting flora and fauna	Turbidity and suspended sediments at sensitive locations and dredging locations	Daily during dredging activities
Shipping, barging and navigation		
To determine the impact of barging	Fate, extent and duration of turbidity (using measurements and aerial photography) in the vicinity of designated barge routes.	Biannually
	Measurements of turbidity and suspended sediments adjacent to the channel and closest seagrass and coral habitats	Weekly
Marine water and sediment quality		
To monitor impacts on marine water and sediment quality	Measurements of water and sediment from sites at risk of pollution	To be established
Benthic primary producer habitat and ecosystem integrity		
Mangroves and algal mats		
To determine if hydrological changes from infrastructure crossing points could affect mangroves and algal mats	Aerial photography, site inspection and permanent surveys transects used to determine changes in sedimentation patterns, potentially affecting mangroves and algal mats at locations to be determined.	Every six months for the first two years following construction. If after two years of monitoring, there are no changes in sedimentation that can be related to the inter-tidal zone as a result of installed infrastructure, then monitoring will revert to surveys every two years.

Purpose	Parameter	Frequency
	The condition and demographic changes to mangrove ecosystems and algal mats in areas reliant on the hydrological design of the field for tidal flushing at locations to be determined.	Every six months for the first two years following construction. If after two years of monitoring, there are no changes in condition or demography, then monitoring will revert to annual surveys.
Coastal processes		
To determine if the project changes the quality and quantity of water entering the benthic primary producer habitat or Gulf.	Sediment transport and nutrient flows from Naughton Creek and Dean's Creek into offshore areas	Quarterly for entirety of project
To determine any shoreline change at Hope Point	Shoreline monitoring in the vicinity of Hope point	Annually for three years after construction. If there are no changes after the third year of monitoring the program will revert to a monitoring programme of every five years.
	Aerial photography – comparison photos used to establish any trends or changes in creek morphology in the vicinity of hope point.	Annually for the first two years following commissioning If after two years of monitoring there are no changes in creek bathymetry or morphology that can be related to the operation of the seawater pumps, then monitoring will revert to bathymetric and aerial photography every two years.*
To determine any creek morphology/bathymetry changes due to alterations of tidal flows and velocities at pump stations	Bathymetric surveys and cross-sectional areas at Naughton Creek, North Creek (unaffected creek north of Naughton Creek of a similar size), Dean's Creek and Scott's Creek (unaffected creek north of Dean's Creek of a similar size)	Annually for the first two years following commencement of seawater pumping in creeks.
Marine fauna		
Underwater noise		
To ensure noise emissions from vessels are the lowest possible	Vessel parts to ensure they are in high states of maintenance	Quarterly
Vessel avoidance		
To determine if vessel avoidance from marine fauna is occurring	Incident report if vessel strike occurs	Opportunistically
To alert ship and barge Masters to the location of humpback whales	Location of humpback whales in vicinity of designated shipping and barge routes	During 20 September to 17 October
Anti-foulants		
To determine the occurrence and distribution of anti-foulants that could impact the marine environment	Sediment quality (particularly TBT) in the vicinity of the barge harbour and ship loading site.	Annually
NIMS		
To determine if they have been introduced and if so, monitor success of control.	Temporal and spatial changes in species present in Exmouth Gulf, particularly at Hope Point barge harbour and anchoring areas	Annually
	Support vessels and other hard structures	Quarterly
Light impacts		
To determine impact from lighting of infrastructure	Light sources	Opportunistically

Purpose	Parameter	Frequency
Seawater pumping		
To determine the incidence of entrapment or mortality of marine fauna	Screens on pump stations and effectiveness of management measure	Hourly for the first 14 days of operation
To determine the impact of entrainment within and external to ponds	Record abundance of fauna within the concentrator ponds	Quarterly
	Monitor abundance and distribution of fauna populations within creek systems	Annually

* This reduction in frequency is proposed as the greatest period of pumping will occur in the first two years after commissioning. If there are no changes in this period, it is unlikely that sudden changes due to the pumping would occur in following years.

The results of monitoring will be reported to the relevant authority annually or as required, which could include:

- Environmental Protection Authority (EPA) Service Unit
- DEC
- Australian Quarantine and Inspection Services (AQIS)
- Department of Fisheries.

3.7 CONTINGENCIES

3.7.1 Changes to water or sediment quality

In the event that monitoring of water or sediment quality shows that dredging, ship and barge movements or concentrator/evaporative ponds have resulted in unanticipated detrimental effects to marine water and sediment quality, the following contingencies will be implemented:

1. Immediate cessation of dredging or ship and barge movements if the effect is the result of dredging.
2. Notification of appropriate regulatory agencies.
3. Review of appropriate management procedures.
4. Review of workforce training.
5. Implement amelioration responses.

Amelioration responses and triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in a Dredging Management Plan that will be prepared prior to the commencement of any dredging/marine excavation activity. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

3.7.2 Ship and barge movements

In the event that monitoring indicates ship and barge movements are exceeding anticipated noise emissions, collision with humpback whales exceeds target level, significant levels of antifoulants in sediments or detection of NIMS not previously found in the Gulf in baseline surveys, the following contingency actions will be implemented:

1. Review management procedures.
2. Notification of appropriate regulatory authority (in the event of a detected incursion of NIMS, an immediate notification of the Marine Biosecurity Unit of the WA Department of Fisheries and WA Consultative Committee on introduced Marine Pest Emergencies (CCIMPE) representative would trigger the WA State Emergency Response Plan. This plan would be implemented by State Agencies and other stakeholders including Straits with national assistance from CCIMPE).
3. In relation to NIMS, inspection, cleaning and as required of support vessels and other hard structure to reduce risk for further translocation.
4. Review of workforce training.

3.7.3 Seawater pumping

In the event that monitoring shows seawater pumping is resulting in recurring entrapment of megafauna or mortality of fauna, or siltation in creeks in excess of anticipated levels that could cause loss of mangroves or algal mats, the following contingency actions will be implemented:

1. Seawater pumping regime or pump station screening will be reviewed and corrective actions developed and implemented to reduce entrapment.

4 GROUNDWATER MANAGEMENT PLAN

4.1 CONTEXT AND SCOPE

The Groundwater Management Plan (GMP) applies to all ground disturbing activities associated with the construction and operational phase of the project, which may have the potential to affect groundwater quality.

4.2 OBJECTIVES

The EPA objectives relevant to this assessment include:

- *To maintain the quantity of water so that existing and potential environmental values, including ecosystem function, are protected*
- *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

The objectives of the Groundwater Management Plan are:

- To minimise the impact of the proposal on groundwater quality and groundwater dependent ecosystems.

4.3 POTENTIAL IMPACTS

The following aspects have the potential to adversely impact on the quality and/or quantity of groundwater resources within the project area:

- **dewatering** during construction could potentially impact water quality and groundwater-dependent ecosystems (including subterranean fauna)
- **storage of hydrocarbons or fuels** could result in spills
- **seepage** from the salt ponds can affect groundwater salinity which may in turn affect mangroves and increase groundwater levels in mainland remnants
- **effluent disposal** from wastewater treatment plants could potentially affect groundwater quality
- **discharge of tailwater** from reverse osmosis plants could potentially affect groundwater quality.

4.4 ENVIRONMENTAL OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

Specific targets and performance indicators relating to groundwater will be developed in consultation with DEC as part of the detailed Groundwater Management Plan that will be prepared prior to construction. The proponent has committed to the preparation of this plan.

4.5 MANAGEMENT ACTIONS

4.5.1 Baseline surveys

The following actions will be implemented with respect to baseline surveys of groundwater:

1. Establish baseline groundwater levels within and surrounding the project area prior to construction.
2. Establish groundwater quality monitoring within and surrounding the project area.
3. Prepare and implement a sampling program to determine the occurrence of subterranean fauna in the groundwater (refer to Terrestrial Fauna Management Plan, section 2).

4.5.2 Dewatering

The following actions will be implemented with respect to dewatering operations:

1. Dewatering will be undertaken only for the construction of the barge harbour and establishment of limestone quarries.
2. Treat dewatering discharges through sedimentation ponds to reduce their turbidity to be less than the mean background levels.
3. Potential extent of acid sulphate soils will be determined and managed in accordance with the Acid Sulphate Soil Management Plan (Section 6, Chapter 2).

4.5.3 Oil and fuel spills

The following actions will be implemented with respect to oil and fuel spills:

1. Construct bunds to contain spills and leaks from fuel storage and handling facilities with impervious material in accordance with Australian Standard *AS 1940-2004: The storage and handling of flammable and combustible liquids.*
2. Design and construct bunds such that the net capacity of each bunded fuel storage facility will be at least 110% of the net capacity of the largest tank.
3. Prepare and implement preventative maintenance procedures for bund walls and floor which will include emptying of bunds after rainfall and regular inspections of bunds using a bund wall inspection checklist.
4. Contain and cleanup spillages of liquid material within bunded areas and dispose at an appropriately licensed solid/liquid waste treatment facility.
5. Prepare and implement as required on-site and off-site emergency preparedness procedures.
6. Prepare and implement spill response and cleanup procedures that include identification of personnel responsible for cleanup, notification of relevant authorities, define timing of response and level of response according to severity of spill, identifying appropriate cleanup material and procedures, list personal protective equipment for cleanup personnel.
7. Store and maintain spill recovery and cleanup equipment at Hope Point.

4.5.4 Discharge of treated wastewater

The following actions will be implemented with respect to the discharge of treated wastewater:

1. Install domestic wastewater treatment systems that meet the Department of Health requirements.
2. Testing the water quality of any treated water to be used for irrigation purposes.
3. Prepare and implement maintenance procedure for domestic wastewater treatment systems and the reverse osmosis plant.

4.5.5 Discharge of tailwater

The following actions will be implemented with respect to discharge of tailwater to the production concentration ponds:

- Prepare and implement maintenance procedure for the reverse osmosis plant.

4.6 MONITORING, REVIEW AND REPORTING PROGRAM

The key monitoring requirements for groundwater are presented in Table 2-6, however there are a number of other management plans that should be consulted in regards to groundwater management including the:

1. Terrestrial Vegetation Management Plan (Section 1, Chapter 2) for vegetation monitoring related to groundwater changes potentially induced by the project.
2. Acid Sulphate Soil Management Plan (Section 6, Chapter 2) for monitoring of groundwater related to potential water quality changes resulting from acidification.

Table 2-6 Key monitoring requirements for groundwater

Purpose	Parameter	Frequency
To determine the effectiveness of infrastructure utilised in the dewatering process	Inspection of dewatering infrastructure including valves, pumps, pipes and hoses	Regularly during the dewatering process
To determine if treated wastewater used for irrigation purposes within the project area is an environmental impact	Groundwater quality (particularly nutrients and contaminants)	Quarterly
To determine if the discharge of treated domestic wastewater or tailwater into evaporative and crystalliser ponds has an effect on the groundwater quality.	Groundwater quality (particularly salinity, nutrients and contaminants)	Quarterly
To determine if groundwater levels are being affected by the project	Groundwater levels	Quarterly

Monitoring data will be reviewed annually by Straits and appropriate sub-consultants and results will be summarised within the AER.

4.7 CONTINGENCIES

In the event that monitoring shows that quality of groundwater throughout the site is adversely affected by seepage and saline water intrusion in mainland remnants the following contingency actions will be implemented:

1. Investigate impact of groundwater change on the biological environment exposed to the change.
2. Notification of appropriate regulatory agencies.
3. Implement corrective action and develop preventative action depending on the extent of environmental effect.

Triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in a detailed Groundwater Management Plan that will be prepared prior to the commencement of construction activities. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

5 SURFACE WATER MANAGEMENT PLAN

5.1 CONTEXT AND SCOPE

The Surface Water Management Plan (SWMP) applies to all ground disturbing activities associated with the construction and operational phase of the project, which may have the potential to impact surface water quality.

5.2 OBJECTIVES

The EPA objectives relevant to this assessment include:

- *To maintain the quantity of water so that existing and potential environmental values, including ecosystem function, are protected*
- *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

The objective of the Surface Water Management Plan is:

- To minimise the impact of the proposal on surface water quality and key ecosystem processes.

5.3 POTENTIAL IMPACTS

Key activities or aspects of the proposal that may potentially affect soils and landform include:

- **diversion or redirection of Yannarie River flows** will alter local hydrology patterns and may cause changes to watercourse morphology
- **impoundment and inundation** as a result of construction of diversion weir may alter vegetation and affect sediment and nutrient transmission pathways
- **storage of hydrocarbons or fuels** with risk of spills that pose a potential threat to water quality and the aquatic flora and fauna that inhabit this environment
- **effluent disposal** poses a potential risk to water quality and the aquatic flora and fauna that inhabit this environment

5.4 TARGETS AND PERFORMANCE INDICATORS

Specific targets and performance indicators for surface water will be developed in consultation with DEC as part of the detailed Surface Water Management Plan that will be prepared prior to construction. The proponent has committed to the preparation of this plan.

5.5 MANAGEMENT ACTIONS

5.5.1 Diversion and redirection of surface water

The following actions are implemented with respect to impacts to watercourses:

1. Reduce, as far as practicable, excavation and extent of levee bank construction.
2. Reduce erosion and sediment mobilisation risk by:
    - limiting clearing and exposed soil working surfaces and protecting them from stormwater erosion
    - siting infrastructure above natural ground level
    - utilise materials from the construction of the barge harbour to offset requirements from borrow pits and quarries
    - construct a flood protection weir to divert hinterland flows away from the saltfield construction areas during major rainfall events.

5.5.2 Impoundment and inundation

Monitoring programs will be prepared and implemented to determine the impact of impoundment and inundation on vegetation and affects on sediment and nutrient transmission pathways (Section 5.6).

5.5.3 Oil and fuel spills

Management actions will be implemented with respect to oil and fuel spills (consistent with those outlined in the Groundwater Management Plan, Section 4).

5.5.4 Effluent disposal

Management actions will be implemented with respect to the discharge of treated wastewater (consistent with those outlined in the Groundwater Management Plan, Section 4).

5.6 MONITORING, REVIEW AND REPORTING PROGRAM

The key monitoring requirements are summarised below and presented in Table 2-7:

1. Stream flows and water quality from the Yannarie River and Rouse Creek to the floodplain and from the four outlet channels to the supratidal flat.
2. Geotechnical monitoring of levee banks including:
    - conduct field geotechnical surveys after all major rainfall events, when floodwaters reach the constructed levee banks. Field surveys will be conducted immediately after the rainfall event when floodwaters have receded sufficient for the area to be safely accessed
    - conduct an annual field based geotechnical survey at a set time once a year. An overall assessment will be made of all the bunds and recordings will also be made from set bench mark locations

3. Erosion and scouring, including:
    - identification of any levee bank breach or geotechnical damage as a result of storm surge or flood damage
    - identification of any areas of scouring and impacts to watercourses.
4. Refer to vegetation monitoring program in Terrestrial Vegetation Management Plan (section Chapter 2).

Table 2-7 Key monitoring requirements for surface water

Purpose	Parameter	Frequency
To determine if surface water within the project area (particularly adjoining streams) is impacted	Water quality (including sediment loads, nutrients and contaminants)	Quarterly or opportunistically after rainfall events
To determine geotechnical capability of bunds and levee banks after storm events	Inspection of structural integrity	Annually or opportunistically after storm events
To determine erosional impacts	Identify eroded and/or scoured areas within the project areas	Opportunistically after storm events

Monitoring data will be reviewed annually by Straits and appropriate sub-consultants and results will be summarised within Annual Reports.

5.7 CONTINGENCIES

In the event that monitoring shows that quality of surface water throughout and adjoining the site is significantly affected (so that health or environmental values are threatened) by construction activities, hydrocarbon spills or the discharge of untreated wastewater, the following contingency actions will be implemented:

1. Review of bund and levee bank construction.
2. Notification of appropriate regulatory agencies.
3. Review of waste water discharge procedures.
4. Corrective action to be undertaken in accordance with the detailed Surface Water Management Plan that will be developed in consultation with DEC.

Triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in the Surface Water Management Plan that will be prepared prior to the commencement of construction. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

6 ACID SULPHATE SOIL MANAGEMENT PLAN

6.1 CONTEXT AND SCOPE

This Acid Sulphate Soil Management Plan (ASSMP) applies to all ground disturbing activities associated with the construction and operational phase of the project, which may have the potential to disturb acid sulphate soils (ASS).

6.2 OBJECTIVES

The EPA objective relevant to this assessment is:

- *To maintain the integrity, ecological functions and environmental values of soils and landform.*

The objective of the Acid Sulphate Soil Management Plan is as above.

6.3 POTENTIAL IMPACTS

Key activities or aspects of the proposal that may potentially affect soils and landforms include:

- **exposure of potential acid sulphate soils** on the supratidal salt flat and the hinterland through the construction of infrastructure and dredging.

6.4 LOCATION OF ASS

Infrastructure components associated with the project have been assessed to determine the risk of ASS production from ground disturbance (Table 2-8).

Table 2-8 Potential areas of soil disturbance and ASS risk

Component	Description	Depth of disturbance	Sediment types to be encountered			ASS disturbance risk
			Intertidal	Intertidal/ Supratidal	Supratidal	
Seawater pumps and associated pipe routes	Pumps will be installed in two tidal creeks, to allow for the pumping of seawater into the salt field.	Piles to ~4 m depth, and in excavation area ~15 m wide, 1 m deep and 25 m in depth	Yes	Yes (though limited to naturally denuded areas)	No	High
Salt conveyor system	A conveyor belt system will be used to load salt from stockpiles to barges. A road will be built alongside the conveyor, and both will be built on an embankment, except over a tidal creek, which will require a culvert.	No soil disturbance (raised embankment)	Yes	Yes	Yes	Low

Component	Description	Depth of disturbance	Sediment types to be encountered			ASS disturbance risk
			Intertidal	Intertidal/ Supratidal	Supratidal	
Barge harbour	Dredging of a barge harbour near Hope Point, for provision of an area where barges can be secured during salt loading.	4 – 5 m	Yes	Limited, if any	No	Low
Barge channel	The barge channel will provide a safe water entry to salt bearing vessels, and will span from the barge harbour to deep water.	5 m	Yes	No	No	Moderate
Infrastructure at Main Island	Infrastructure includes emergency accommodation, fuel supply area, power station, washing areas and service roads.	Built on limestone outcrop where possible, or to shallow depths. Not considered an ASS risk	No	No	Yes	Low
Borrow pits	Borrow pits will be located in the Carnarvon Dune hinterland, and will supply clay for construction.	Excavation of clay from the Carnarvon Dune is not considered to be an ASS risk	No	No	No	Low
Pond walls	Impermeable clay walls will be will be constructed on existing supratidal salt flat and will be used to frame crystallisation and evaporation ponds	No soil disturbance (to be constructed on top of existing salt flats)	No	No	No	Low
Airstrip at Hope Point	To be built on an embankment built up over the limestone embankment at Hope Point.	Built on embankment therefore not considered ASS risk	No	Limited, if any	Yes	Low

6.5 MANAGEMENT ACTIONS

The heterogeneous nature of sediment across the project area and the different degrees of inferred risk associated with each sediment type (Table 2-9), necessitates the need for a variety of ASS management strategies to be employed in the areas of potential disturbance.

6.5.1 Baseline surveys

The following management actions will be implemented with respect to baseline surveys of ASS:

1. Further sampling within areas deemed to be potentially moderate and high ASS risk:
    - soil bores installed over representative areas
    - soil testing
    - logging of soil bore lithologies
    - identification of depth interval in bores with the highest acid generating potential.

Baseline surveys will be undertaken prior to construction.

6.5.2 Soil sampling and analysis

The following management actions will be implemented with respect to ASS sampling and analysis:

1. Undertake soil sampling in moderate and high risk ASS areas, as described in Table 2-9, below.
2. Install soil bores to 1 m below the proposed depth of excavation.
3. Log soil bore lithologies in accordance with the USCS classification system and collect soil samples at a relevant density representative of investigation area, or opportunistically if appropriate, in augered sediments.
4. Undertake pH_F and field pH_{FOX} measurements on all samples collected.
5. Undertake laboratory testing for acid generating capacity testing using the Chromium Reducible Sulphur Suite, of the depth interval within each soil bore identified as having the highest acid generating capacity, based on field testing.
6. Undertake laboratory testing of at least 2 samples from each lithological unit (within each investigation area) for acid generating capacity using the Chromium Reducible Sulphur Suite
7. Undertake laboratory testing of at least 1 in 10 soil bores for acid generating capacity using the Chromium Reducible Sulphur Suite.
8. Send soil samples with $pH_F<4$ and $pH_{FOX}<3.5$ to the laboratory for acid generating capacity testing using the Chromium Reducible Sulphur Suite, or if all samples in a specific augered hole meet this criteria, undertake sampling and analysis of representative soil depth samples at a minimum of 0.5 m intervals through the bore profile.
9. If acid generating soils are identified, samples will also be analysed for their heavy metal content.

Table 2-9 ASS risk and associated sampling requirements

Component	Sediment Risk Category	Disturbance type	Disturbance volume or length	Sampling Needs*
Seawater pumps	HIGH	Non-linear	5,000 m^3	10 auger holes
Seawater pipe routes	HIGH	Linear	none	1 auger hole every 500 m*
Salt conveyor system	LOW	Linear	None	1 auger hole every 500 m*
Barge harbour dredging	MODERATE	Non linear	800,000 m^3	10 auger holes
Barge channel dredging	MODERATE	Non linear	280,000 m^3	1 bore every 100 m#
Infrastructure at Main Island	LOW	Non linear	None	None
Borrow pits	LOW	Non linear	6,000,000 m^3 (maximum)	None
Pond walls	LOW	Non linear	None	None
Airstrip at Hope Point	LOW	Non linear	none	None

*Note: Sampling used only where excavation is required; #Underwater, depends on spoil disposal

6.5.3 General ASS

The following management actions will be implemented with respect to management of general ASS issues:

1. Design the seawater conveyance route to minimise their disturbance to areas of algal mat and mangrove to reduce to risk of disturbing the mangrove silts, muds and marine sands.
2. Transport seawater in above group open flumes, thereby avoiding the need for any excavations.
3. Classify and stockpile materials suspected to be ASS.
4. Treat and dispose of confirmed ASS materials.

6.5.4 ASS treatment and analysis

The following management actions will be implemented with respect to ASS treatment and analysis:

1. Sediments identified as exceeding the action criteria of 0.03% S or 18 mol H^+/tonne will be considered acid generating and will be managed to minimise their risk of acid generation if disturbed.
2. Sediments identified as acid generating will be handled and treated by:
    - reburial and capping of soils, and
    - neutralisation of soil using lime sands.

Reburial and capping of soils

The construction of the armoured sea wall is likely to utilise locally sourced limestone from Hope Point and other quarries. Excavation of this limestone may result in the creation of open, limestone pits. These pits may provide a location to dispose of all or some of the acid generating soils as these pits inherently have an unlimited neutralising capacity. If untreated acid sulphate soils are reburied in the lime pits, the following management practices will be adopted:

- untreated soils disposed to the limestone pit in layers will be compacted and covered with crushed lime sand based on acid base accounting
- compacted crushed lime sand to be used to cap the pits
- a suitable topsoil cover is reinstated on top of the completed pits; and
- the location of the limestone pits are mapped and kept on a site register that will include pit dimensions, volume of ASS emplaced and actual methodology used in the encapsulation process.

Neutralisation of soils

Aglime or lime sands are the most effective neutralising materials for the treatment of acid sulphate soils. Lime sourced from the site will be crushed to a suitable fineness prior to application. The following practices will be adopted for the neutralisation of acid generating soils:

- If the effective neutralising value (ENV) of the lime is not pre-determined (as in the case where it is sourced from the site), analysis for Calcium Carbonate Equivalence (CCE) by a NATA accredited laboratory to determine the ENV of the material will be undertaken. The CCE will be tested on the crushed lime at a rate of approximately 1 analysis per 500 m^3.

- The ENV used for calculating the neutralisation material dosing ratio for the treatment of soils is based on the average ENV value obtained from the laboratory analysis.
- The initial amount of neutralising material required will be calculated based upon the highest percent of oxidisable sulphur (or acidity as kg H_2SO_4/tonne) concentration and the ENV of the material to be used as a neutralising agent (Note: the high amount of gypsum in the sediments may affect this relationship and will be further investigated). A minimum safety factor of 1.5, which applies to Aglime with an ENV = 0.95 (95%), is applied to the neutralisation rate (Department of Environment 2003).
- The neutralisation rate will be calculated as follows:

  Lime required (kg $CaCO_3$/tonnes untreated soil) = (kg H_2SO_4/tonne) x (1.5 / ENV) or

  Lime required (kg $CaCO_3$/tonnes untreated soil) = (S% x 30.59) x (1.5 / ENV)

  Where:

  - kg H_2SO_4/tonne is net acidity (actual and potential) in acidity units
  - S% is net acidity (actual and potential) in sulphur units
  - ENV is the neutralising value expressed as a decimal percentage (e.g. 0.95 for 95%).
- Acid generating soils, unless stored under a wet cover system, will be mechanically mixed with the neutralisation material on a mixing pad preferably with a 300 mm crushed lime base or alternatively on an area overlying calcarenite/limestone substrate if available. If required, the following practices will be undertaken for the most effective soil neutralisation process:
  - where possible, soils should be segregated by soil type for treatment
  - neutralisation is undertaken by uniformly blending soils with the neutralising agent
  - following neutralisation the soil will be stockpiled on designated pad for validation testing before encapsulation.
- The following sampling and analysis programme will be undertaken to validate the neutralisation of the soils:
  - pH_F and pH_{FOX} testing is undertaken at a rate of approximately 1 sample per every 500 m^3 of soil treated
  - When pH_F and pH_{FOX} are found to be within the performance criteria (Section 6.4), two in every ten field samples will be randomly selected and sent to the laboratory for confirmatory analysis using the Chromium Reducible Sulphur Suite and laboratory pH and pH_{OX}.

Soils that are not reburied and that have been verified as neutralised have the potential to be used as construction material. The possible utilisation options for the treated soils include use as soil cover for the rehabilitation of the borrow pits and use as fill for haul roads. Other utilisation options can be considered following confirmation of treated soil types. Approval for use needs to be obtained by the site Environmental Manager or a qualified geotechnical engineer.

6.6 MONITORING, REVIEW AND REPORTING PROGRAM

Monitoring of groundwater for impacts associated with ASS will occur in areas where there has been:

- intrusion and/or disturbance of potentially acid generating soils, especially where there has been dewatering
- stock-piling or disposal of potential acid sulphate soils.

The key monitoring requirements are summarised in Table 2-10.

Table 2-10 Key monitoring requirements

Component	Risk	Dewatering required (Y/N)	Monitoring needs
Seawater pumps and associated conveyance routes	High risk	No	None needed
Salt conveyor system	Low risk	No	None needed
Barge harbour	Low to moderate risk	Yes (construction phase only)	Check in-situ water pH prior to re-flooding
Barge channel	Low to moderate risk	No	None needed
Infrastructure at Main Island	Low risk	No	None needed
Borrow pits	Low risk	No (no excavation below water table	None needed
Pond walls	Low risk	No	10 wells across project length, depending on results of soil investigation.
Airstrip at Hope Pt	Low risk	No	None needed

Performance criteria will be adopted for the site prior to construction (Table 2-10). Due to the hypersaline nature of the shallow groundwater, performance indicators will depend upon site specific shallow groundwater investigations (e.g. natural concentrations of trace and major ions), which will be undertaken post pre-feasibility. For all other performance criteria the standard DEC guidelines pertaining to acid sulphate soils will be applied.

Table 2-11 Performance criteria for sediment, leachate and groundwater

Medium	Acceptable threshold	Exceedance triggering contingency plans
Neutralised soil	pH_F > 6.5	pH_F < 6.5
	pH_{FOX} > 6.5	pH_{FOX} < 6.5
	Net Acidity <18 mol H+/tonne	Net Acidity > 18 mol H+/tonne
Run-off leachate	8.5<pH>6.5	pH<6.5
	TAc<35 mg/L	TAc>35 mg/L
Groundwater monitoring	TAc-TAlk < 35 mg/L	TAc-TAlk > 35 mg/L
	8.5<pH>6.5	pH<6.5
	EC mS/cm	Concentrations to be determined post pre-feasibility, where the suite in the column is the expected suite of trace element analytes, where exceedence relates to site specific hydrogeochemical conditions.
	SO_4/Cl	
	Fe mg/L	
	Al mg/L	
	As mg/L	
	Se mg/L	
	Zn mg/L	
	U mg/L	

TAc = Total Acidity; Talk = Total Alkalinity

6.7 CONTINGENCIES

In the event that monitoring of ASS shows that construction activities have resulted in acidic sediment, leachate or groundwater, the following contingency plans will be implemented if the aforementioned performance criteria are exceeded:

- If field pH_F and pH_{FOX} results of soil validation samples are outside the acceptable thresholds, further lime treatment of soils will be undertaken prior to retesting and submission of samples to the laboratory.
- If laboratory analysis of treated soils are outside of the Total Potential (mineral) Acidity + Total Actual Acidity criteria, further lime treatment of soils will be undertaken prior to encapsulation or use on-site.
- Further lime dosing of leachate run-off will be undertaken prior to release to the environment if pH of the water is less than 6.5 or Total Acidity >35 mg/L.
- If field monitoring indicates that groundwater has been adversely impacted, more frequent laboratory analysis will be undertaken and a suitable management strategy will be developed in consultation with the DEC.

Triggers for the implementation of these contingencies will be developed in consultation with the DEC and included in a detailed Acid Sulphate Soil Management Plan that will be prepared prior to the commencement of any ground disturbing activity. The Plan will be prepared in consultation with the DEC and to the satisfaction of the EPA.

7 ABORIGINAL SITES MANAGEMENT PLAN

7.1 CONTEXT AND SCOPE

There are two Native Title claims covering the area around the proposed development site, namely the Thalanyji Claimant Application (WC99/45) and the Gnulli Application (WC97/28) (National Native Tribunal Register 2004). A number of Aboriginal sites, all archaeological, have been identified in the area of the Yannarie Solar Project.

The heritage management process has been agreed to by both native title parties and Straits will continue to work with both parties to ensure heritage is protected as much as possible.

7.2 OBJECTIVES

The EPA objective considered relevant to this assessment is:

- *To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.*

The objectives of the Aboriginal Sites Management Plan are:

- *To avoid or minimise impacts to Aboriginal heritage sites.*
- *To comply with the requirements of the Aboriginal Heritage Act 1972 and Native Title Act 1993.*

7.3 POTENTIAL IMPACTS

Activities or aspects of the proposal that may potentially affect Aboriginal sites include:

- **ground disturbance** impacts on Aboriginal heritage and cultural values
- **restriction of access** to customary use of the land and cultural heritage sites.

7.4 TARGETS AND PERFORMANCE INDICATORS

Specific targets and performance indicators for surface water will be developed as part of the detailed Aboriginal Sites Management Plan that will be prepared prior to construction. The proponent has committed to the preparation of this plan.

7.5 MANAGEMENT ACTIONS

7.5.1 Baseline surveys

A heritage survey will be conducted in all areas that will be disturbed, before earthworks commence.

7.5.2 Identified Aboriginal sites

The following actions will implemented with respect to disturbance of Aboriginal sites:

1. Prepare and implement procedures for protecting Aboriginal heritage sites identified in the baseline surveys.
2. Avoid Aboriginal Heritage sites wherever practicable.
3. If any disturbance of identified archaeological sites is required, traditional owners will be consulted and application for consent under Section 18 of the *Aboriginal Heritage Act 1972* will be made.
4. Prepare and implement heritage and culture awareness programs for employees and contractors, including information regarding their responsibilities under the *Aboriginal Heritage Act*.
5. Engage Aboriginal heritage monitors during ground disturbing works in the vicinity of known Aboriginal sites.
6. If any archaeological material not previously identified is found during construction, work will cease immediately within a nominal 20 metres of the find. A qualified archaeologist will be engaged to undertake appropriate recording or protection measures, and advise the relevant stakeholders as required.
7. If any human skeletal material is uncovered Straits will advise the contract Superintendent's representative immediately. The Police Department will be contacted by Straits and the site immediately secured by the contractor. A qualified anthropologist and the relevant native title party will be contacted to undertake appropriate measures in consultation with the Police.

7.6 MONITORING, REVIEW AND REPORTING PROGRAM

Heritage surveys will be carried out prior to construction in areas to be disturbed by clearing. During earthworks in the vicinity of known Aboriginal sites, a heritage monitor will be present to watch for any archaeological material disturbed during construction.

7.7 CONTINGENCIES

In the event that monitoring of Aboriginal sites shows that construction activities have resulted in detrimental effects to these sites or additional sites are discovered, the following contingency actions will be implemented:

1. Immediate cessation of works.
2. Consultation with representatives of the relevant Aboriginal group(s).
3. If any archaeological material not previously identified is found during construction, work will cease immediately within a nominal 20 metres of the find. A qualified archaeologist will be engaged to undertake appropriate recording or protection measures, and advise the relevant stakeholders as required.

If any human skeletal material is uncovered Straits will advise the contract Superintendent's representative immediately. The Police Department will be contacted by Straits and the site immediately secured by the contractor. A qualified anthropologist and the relevant native title party will be contacted to undertake appropriate measures in consultation with the Police.

8 PRELIMINARY CLOSURE MANAGEMENT PLAN

8.1 CONTEXT AND SCOPE

This Preliminary Closure Management Plan (PCMP) specifically covers the costs and activities associated with closing and rehabilitating the disturbance caused by Straits Yannarie Solar Project within its Mining Tenure under the *Mining Act 1976*. Initial costings are based on the disturbance required to construct and operate a 3 million tonnes per annum (Mtpa) salt field that is the expected initial development and operational phase of an eventual 10 Mtpa. The PCMP will be expanded to incorporate the costs and activities associated with a 10 Mtpa saltfield as it develops with a life expectancy in excess of 60 years.

The plan incorporates disturbance associated with the construction of the facilities for salt production activities, including transportation and conveying corridors, barge harbour, wash plant, seawater evaporation ponds and salt crystallizer ponds and ancillary operations such as warehousing, administration, fixed and mobile maintenance. Rehabilitation required for temporary disturbances (including construction camps, lay-down areas and some access tracks) has been addressed in the Terrestrial Vegetation Management Plan (Section 1, Chapter 2).

As this plan is being prepared prior to actual disturbance being undertaken, the closure plan has been developed as a conceptual model only. Once construction and commissioning has occurred, actual closure liabilities will be calculated based on the level of disturbance at the appropriate time for review. This will allow Straits to determine its closure liabilities at the appropriate current values reflective of consumer price index (CPI) increases between now and then. Regular updates are now part of the International Finance and Accounting Standards where-by rehabilitation costs are reviewed on a six monthly basis. Straits also has an internal corporate requirement to update Life of Mine Business Plans on an annual basis that also requires closure liabilities to be identified and quantified.

This specific Plan has been compiled to meet the requirements of the Western Australian Environmental Protection Authority, Department of Industry and Resources, Department of Environment and Conservation and Straits Resources Limited, the 100% owner and parent company of Straits Salt Pty Ltd.

8.2 OBJECTIVES

The EPA objectives relevant to the PCMP are:

- *To maintain the integrity, ecological functions and environmental values of soils and landforms.*
- *To ensure as far as practicable, that rehabilitation achieves a stable and functioning landform that is consistent with the surrounding landscape and other environmental values.*

The broad site closure objectives for Straits are to:

- Ensure that, as far as is practical, the desires and needs of its stakeholders are met.
- Comply with all relevant legal and other requirements.
- Vacate the site in a safe and stable condition.
- Set aside adequate provisions to meet closure costs.
- Obtain relinquishment of Leases.

8.3 CLOSURE ASPECTS AND SCENARIOS

Aspects of the project that will be considered during closure planning have been identified and described in Table 2-12. Aspects were determined by considering activities necessary to successfully remediate and close the site.

Table 2-12 Closure aspects and descriptions

Aspect	Description
Buildings, including: • mobile workshop • fixed plant workshop • laboratory • administration • warehouse.	The cost estimate will be based on a cost per square metre of floor space, once buildings have been constructed. This will include the removal of all buildings and their footings and spreading of topsoil and seeding.
Roads and airstrip	It is presumed that no roads will remain following closure, except possibly the main access track should the pastoralist with the underlying lease wish it to stay. The airstrip will be decommissioned and the land rehabilitated.
Salt stockpile and wash plant areas	It has been assumed that regardless of the situation resulting in site closure, all remaining stockpiles will be sold. The washplant will be removed.
Concentrator and crystalliser ponds	Ponds will be remediated by disposing of the brine through further processing via bitterns treatment for commercial sale or if this is not viable, operating through the bitterns management system and allowing any residual liquid to evaporate as much as possible. The methodology for remediating the base of the ponds is yet to be determined, however it will be developed in a consultative manner with Government and key stakeholders. The objective will be to minimise disturbance of the underlying areas, while ensuring that the natural energy flows of the system and hinterland surface water runoff is not adversely impacted.
Bridges and trestle structures	All terrestrial structures will be removed to below ground level to ensure there is no impedance to surface water flows. All structures within the marine environment will be removed to seabed level to ensure they do not pose a threat to shipping or trawling operations and to ensure that tidal and current flows are not affected.
Barge harbour	The barge harbour will remain, however any associated infrastructure will be removed.
Borrow pits	Borrow pits will be progressively rehabilitated to agreed standards and identified completion criteria.
Environmental monitoring	It is assumed that some level of environmental monitoring will be required post closure. This will be dependent on the level of sign-off prior to actual closure. To ensure that rehabilitation is progressing satisfactorily along the succession pathways identified in the completion criteria, it is assumed that monitoring of rehabilitated land will also be required for a period post closure.
Management costs	The cost of managing the decommissioning the salt field at closure and managing the implementing the closure works is set as 10% of final estimated closure cost until actual costs can be calculated closer to final implementation of the works.
Contingency	A 20% contingency will be added to the closure cost estimate for the first few years. It is expected that this percentage will decrease over time as greater confidence is gained in the accuracy of the available data.

Aspects of closure identified in Table 2-12 were analysed, and three potential closure scenarios were determined for each aspect (Table 2-13). The most likely scenario was identified, taking into account the short to long-term closure objectives. This allowed each of the activities to be prioritised; however in practice, many will be undertaken concurrently. Costs have not been estimated due to the current lack of detailed engineering investigations. Preliminary closure objectives and key management actions are outlined in Table 2-14.

Table 2-13 Summary of closure scenarios

No.	Aspect	Scenario 1	Scenario 2	Scenario 3	Most likely
1.	Buildings	Demolition of all infrastructure and rehabilitate disturbed area to agreed end land use	Some buildings to be relocated off site for use by third party with remaining infrastructure to be demolished and disposed of off site	All buildings to be either demolished and disposed of off site or relocated off site for use by third party	Scenario 2
2.	Roads and airstrip	Rip up and rehabilitate all roads and the airstrip	Leave main access road from the Gazetted Road to the project area and remove all internal roads and the airstrip	Leave all access roads to allow access to third parties and the pastoralist including the airstrip	Scenario 2
3.	Salt stockpile and washplant areas	All remaining stockpiles will be sold and washplant infrastructure removed	All remaining stockpiles will be sold with earthen storage bunds to be removed and spread out evenly	Market collapses and unable to sell existing stockpiles, requiring that all material be discharged in an environmentally acceptable manner	Scenario 1
4.	Concentrator and crystalliser ponds	Brine left to evaporate over long period and solids left in place. Salt product sold. Embankments breached to allow water flows, any removed material potentially used to backfill borrow pits	Remaining brine discharged in an environmentally acceptable manner from crystalliser ponds and residual liquors left to evaporate. Salt product sold. Some pond structures remain for alternative land use (e.g. Aquaculture, wetland construction)	Some pond structures to remain in place and become alternative end land use, potentially operated by a third party (e.g. aquaculture)	Scenario 2
5.	Bridges and trestle structures	All structures completely removed and material disposed of off site	All structures removed to ground or sea bed level and material disposed of off site	All terrestrial structures removed to ground level and marine structures cut off at least 3 m below the surface water level with material disposed of off site	Scenario 2
6.	Borrow pits	Backfilled using suitable excavated material from salt field decommissioning and then rehabilitated (contoured, ripped, seeded). Borrow pits to remain open until site closure	Specific pits identified for potential backfill using suitable material to be recovered from embankment demolition etc. and rehabilitated (contoured, ripped, seeded). Pits not identified to be backfilled to be recontoured, and rehabilitated progressively over the life of the operations	No backfilling of pits to occur, voids recontoured, and rehabilitated progressively over the life of the operations (ripped, seeded)	Scenario 2
7.	Sea walls	All sea walls completely removed, with material used to backfill borrow areas, limestone rock armouring collected and sold locally	Sea walls breached in key strategic areas to allow natural energy flows (water and nutrients. Removed limestone collected and sold locally	Sea walls kept in place for alternate land use (e.g. aquaculture or wetland maintenance)	Scenario 2
8.	Environmental monitoring	Post closure monitoring not required as end point criteria met prior to final decommissioning	Design and install a comprehensive environmental monitoring system with a period of approximately 5 years post closure monitoring to demonstrate compliance with agreed end point criteria	Design and install a comprehensive environmental monitoring system with a period of >10 years post closure monitoring to demonstrate compliance with agreed end point criteria	Scenario 2
9.	Management costs	Planning and supervision managed using internal personnel on a part time basis	Planning and supervision managed using internal personnel on a full time basis	Planning and supervision managed using external personnel on a full time basis with some assistance from internal personnel	Scenario 3

Table 2-14 Preliminary closure objectives and key management actions

No.	Area	Closure objective	Actions		
			Short term	Medium term	Long term
1.	Buildings	Remove unwanted buildings and dispose of material either through recycling (scrap metal) or off site disposal	• Review demolition cost/m^2 to determine cost • Seek quote from demolition contractor	• Demolition of unwanted buildings • Removal of material • Recontouring and rehabilitation of disturbed areas	• Monitoring • Maintenance
2.	Roads	Remove all roads and paved areas that have no post closure land use. Rehabilitate areas to an agreed end land use (pastoral or conservation or other)	• Consult with immediate stakeholders and confirm requirements	• Remove all unwanted roads, deep rip and rehabilitate	• Monitoring • Maintenance
3.	Salt stockpile areas	Sell remaining product, remove necessary embankments and remediate to an agreed end land use	• Review disposal options for salt of potentially lower grade and embankment material	• Removal of salt and necessary embankments • Re-contouring and rehabilitation of disturbed areas	• Monitoring • Maintenance
4.	Concentrator and crystalliser ponds	Safely dispose of brine, sell remaining product, remove necessary embankments and remediate to an agreed end land use	• Review end land use options and develop closure strategies to satisfy legal and other requirements	• Removal of necessary above ground material • Implementation of alternative end land use options • Re-contouring and rehabilitation of disturbed areas	• Monitoring • Maintenance
5.	Bridges and trestle structures	To remove to such an extent as to minimise any environmental disruptions and ensure no safety risk remains	• Incorporate this task into the establishment of completion criteria	• Implement agreed removal options • Re-contouring and rehabilitation of disturbed areas	• Monitoring • Maintenance
6.	Borrow pits	Backfill where practicable and suitable material is available. Rehabilitate voids to acceptable standard through contouring and revegetation	• Minimise initial disturbance • Stockpile topsoil and utilise in rehabilitation as soon as possible.	• Backfill voids with selected material (non contaminated) recovered from the removal of infrastructure • Progressively rehabilitate backfilled and unfilled pits	• Monitoring • Maintenance
7.	Sea walls	Safely dispose of embankment material and limestone used for rock armouring (sell). Ensure that surface water flows are functional based on selective removal of material. Remediate to an agreed end land use	• Review end land use options and develop closure strategies to satisfy legal and other requirements	• Removal of any necessary above ground material • Implement alternative end land use options – e.g. aquaculture	• Monitoring • Maintenance

No.	Area	Closure objective	Actions		
			Short term	Medium term	Long term
8.	Environmental monitoring	Implement a post closure monitoring program to demonstrate compliance with closure objectives	• Determine requirements of monitoring program based on measures of closure success	• Plan to ensure adequate resources and training • Implement program progressively	• Review effectiveness • Determine end point to monitoring programme
9.	Management costs	Train internal staff and or contract personnel with specific closure planning skills to oversee decommissioning	• Hire necessary personnel • Establish closure team and set objectives and performance indicators	• Post closure review • Assess against established criteria	• Employ or contract staff to implement and maintain post closure monitoring programme • Implement any post closure maintenance programs identified through the monitoring programme

8.4 COMPLETION CRITERIA

The overarching completion criterion for rehabilitation is to 'establish a self-sustaining ecosystem with species composition and ecological function compatible with undisturbed surroundings'. The development of specific completion criteria (or end land use criteria) is critical; however this can only be achieved throughout the operational phase of the project and after adequate consultation has occurred with Straits' stakeholders. There are a number of options being considered, which include:

- retaining a number of ponds for aquaculture projects
- removal of seawalls
- breaching of pond walls to allow natural energy and surface water flows throughout the system.

As stated above, closure criteria will be developed during the operational phase in a consultative manner.

8.5 STAKEHOLDER CONSULTATION

Stakeholder Liaison Groups (SLG's) have been established as part of the environmental impact assessment process. The SLG's consist of a broad cross section of the community to ensure that widespread feedback is obtained. These forums will be used to discuss closure options in the lead up to a planned site closure.

In addition to this, the local pastoralists and Government departments such as the Department of Environment and Conservation, and Department of Industry and Resources, will be consulted routinely throughout the life of the project to ensure that end land use and suitable completion criteria are established.

8.6 REVIEW AND REPORTING

The closure planning process is dynamic and will require regular review and further development throughout the life of the operation. The PCMP will be periodically updated, to incorporate changing legislative requirements, technical improvements, cost increases, changes to the needs of stakeholders and changes to environmental best practice techniques. It also allows for future negotiations on end land use and completion criteria suitable for the location.

Appendix 1
Vegetation Clearing Permit

Vegetation Clearing Permit

Required to be completed for ALL activities that will, or have the potential to, impact upon native vegetation or topsoil within the Yannarie Solar project area.

Company Completing Work: Responsible Person:

Commencement Date: Completion Date:

Signed:

Description of Work (including justification why clearing is required):

.....
.....
.....
.....
.....
.....
.....
.....

Area to be disturbed: .....m^2/ ha

Attach one of the following depicting the location to be cleared (please tick):

Map ☐ Photo ☐ Diagram ☐ Other ☐

Government Approvals Required (please tick yes or no for each line item)

Note: If unsure, you will need to liaise with the Department of Environment and Conservation (DEC).

Approval	Yes	No
Native Vegetation Clearing Permit	☐	☐
Ground Disturbance Approval Application (GDAA)	☐	☐
Notice of Intent (Mining Proposal) or NOI/Mining Proposal variation	☐	☐
Section 17 Permit to Modify Stream Beds or Banks	☐	☐
Other – Provide details: ……	☐	☐

Approval Checklist:

Requirement	Date Completed	N/A	Initial of person making declaration
All necessary Government approvals have been obtained (see section on Government approvals)			
The area to be cleared has been surveyed and marked prior to clearing (where possible native vegetation should be avoided)			
To reduce the potential for the spread of weed species, off site vehicles must be washed down and/or inspected prior to entering work areas to ensure that no soil or plant material exists on or under the vehicles			
Arrangements have been made for the immediate reuse of topsoil, or if not possible, for the appropriate stockpiling of topsoil. Advice should be sought from the Environment Section if required			
Clearing Permit submitted to the DEC			
Permit signed by DEC and Project Manager prior to any work commencing			

I confirm that I have read and understand the requirements of the Vegetation Clearing Environmental Management Plan and this land clearing permit and that I will comply with those requirements.

.....

Person Responsible for Land Clearing Signed

..... Date

Approval section:

.....

Environmental Officer Signed

..... Date

Any comments or further conditions:

.....

.....

.....

.....

Project Manager Signed

..... Date

Any comments or further conditions:

.....

.....

.....

After Works Have Been Completed:

I confirm that the requirements of this Land Clearing Permit have been met and that all land clearing completed under this permit was within the boundaries of the nominated area.

……..……

Person Responsible for Land Clearing Signed

..... Date

Note: The person responsible for the works under this permit must return the completed form to the Environment Department within 7 days of the completion of works.