Yannarie Solar
a Straits initiative

# Response to submissions

## Yannarie Solar Environmental Review and Management Programme

## SECOND PUBLIC REVIEW

May 2008

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## EXECUTIVE SUMMARY

Straits Salt Pty Ltd (Straits) is proposing to construct and operate a solar saltfield on the eastern margin of the Exmouth Gulf (the Gulf) in Western Australia known as the Yannarie Solar Project (the project).

An Environmental Review and Management Programme (ERMP) was prepared for assessment by the Environmental Protection Authority (EPA). The ERMP was originally subject to a 12 week period of public review following its release on 4 December 2006.

In response to public submissions Straits has revised this proposal to reduce the size of the project footprint and plans to construct and operate a reduced nominal 4 Mtpa solar salt field. At the request of the EPA a Modified Proposal document and supplementary documentation were released for a further 4 week public review period commencing on 25 February 2008. The supplementary documents included supporting technical documents and updated draft management plans.

The additional public review period resulted in 18 submissions from 16 different organizations and individuals. Straits has responded to all of the submissions raised in relation to the project and has demonstrated how all of the critical issues have been adequately addressed. In summary, the following conclusions have been drawn.

- The ecosystem function and natural value of the Nationally Listed Wetland in the project area will be protected. The design of the project, including the increased minimum setbacks of 100m from the algal mat, will ensure the tidally driven ecosystem, including nutrient cycles are maintained.

- The modified proposal, including a significantly reduced footprint, has been designed to allow full outflows from Rouse Creek and Yannarie River across the salt flats to the sea.

- Using accepted engineering standards and natural landscape features, the project will provide structural integrity of the levees and bitterns management area in the event of storm surge and cyclones.

- Additional drilling across the supratidal flats has confirmed the existence of the low permeability surficial aquifer underlain by a thick clay sequence preventing vertical movement of salt pond brines. In most instances the salinity of the surficial aquifer is greater than the salinity in the overlying pond brines.

- Western Australia has a long history in the design, assessment, construction and regulation of solar salt fields, including bitterns discharge. It is apparent from the various EPA assessments relating to salt field development that there is yet to be any significant environmental impacts identified from current bitterns discharge management (EPA, 1990, 1995, 1999). Additionally, the Yannarie Solar Project is a no-discharge proposal based on resource recovery principles.

Straits believe that they have demonstrated how the significant conservation values of the Exmouth Gulf will be protected and enhanced through contributions to ongoing research and community based monitoring initiatives which will be implemented through the Yannarie Solar Project. These benefits will be realized for the considerable life of the project.

# 1. INTRODUCTION

Straits Salt Pty Ltd (Straits) is proposing to construct and operate a solar saltfield on the eastern margin of the Exmouth Gulf (the Gulf) in Western Australia. Known as the Yannarie Solar Project (the project), the operation will meet the rapidly growing demand for salt stemming from the Asia-Pacific region. The original proposal was for a nominal 10 million tonne per annum (Mtpa) solar salt field. However, in response to public submissions about the scale of the development, Straits has revised this proposal to reduce the size of the project footprint. Straits now proposes to construct and operate a nominal 4 Mtpa solar salt field.

An Environmental Review and Management Programme (ERMP) was prepared for assessment by the Environmental Protection Authority (EPA) pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The ERMP described the proposal, detailed the existing environment, examined likely environmental impacts and outlined proposed commitments and management, including management plans for specific issues.

The ERMP was originally subject to a 12 week period of public review following its release on 4 December 2006. The public review period was extended by two weeks, and closed on 12 March 2007.

At the request of the EPA a Modified Proposal document and supplementary documentation were released for a further 4 week public review period commencing on 25 February 2008. The supplementary documents, including supporting technical documents included:

- Hope Point Habitat Mapping 2007 (Oceanica 2008) [benthic habitat mapping].
- Yannarie Solar Project Subterranean Fauna Assessment (Biota Environmental Sciences, 2008).
- Yannarie Solar Project: Additional Flora and Vegetation Assessment (Biota Environmental Sciences, 2008).
- Hydrogeological Investigation of Supratidal Flats, Yannarie Solar Project (Parsons Brinckerhoff 2008).
- Yannarie Salt field environmental investigations: Mixing and dilution of Bitterns C discharge (APASA, 2007).

The following updated Draft Management Plans were also publicly available:

- Draft Acid Sulphate Soils Management Plan
- Draft Cultural Heritage Management Plan
- Draft Groundwater Management Plan
- Draft Hydrocarbon Spill Contingency Management Plan
- Draft Marine Management Plan
- Draft Preliminary Closure Management Plan
- Draft Surface Water Management Plan
- Draft Terrestrial Fauna Management Plan
- Draft Terrestrial Vegetation Management Plan.

The additional public review period resulted in 18 submissions from 16 different organizations and individuals.

## 2. DOCUMENT STRUCTURE

This document presents a response to issues raised which have not been previously addressed as part of the additional period of public comment on supplementary documents related to the Yannarie Solar Project ERMP.

The submissions were reviewed to identify the new issues raised and these issues were then grouped into the same environmental aspects used for the first volume of Response to Submissions (First Public Review). Detailed responses to issues are presented in Section 3 of this report.

The full list of submitters and a summary of the issues raised is presented in Section 4. Cross references have been provided against issues raised in submissions, to indicate where they are addressed in detail.

## 3. RESPONSES TO KEY ENVIRONMENTAL ISSUES

The new issues raised (those not previously addressed in the Response to Submissions (First Public review) were grouped into the following categories:

- General
- Soils and Landforms
- Groundwater
- Surface Water
- Terrestrial vegetation and flora (excluding mangroves)
- Terrestrial Fauna
- Benthic Primary Producers habitat and ecological integrity
- Marine Fauna
- Commercial Fishing and Aquaculture
- Recreation and Tourism
- Cultural Heritage and conservation values
- Coastal processes, sea level rise, major storms, climate change
- Closure and rehabilitation
- Sustainability
- Bitterns.

## 3.1 GENERAL

### 3.1.1 Possible Future Expansion of Proposal

It was submitted that the proponent has detailed in a community stakeholder reference group meeting of 7 June 2007 that Straits will extend the modified project in due course and that this full size project should be assessed by the EPA.

The only proposal which Straits is proposing to build and operate is the modified proposal represented in the Modified Proposal document (Straits 2008b).

General discussions have been held with the Exmouth Stakeholders, including the possibility of future expansions if economic viability and environmental sustainability could be proved. It was also reiterated that any proposed expansion would be a matter for the EPA to assess if ever a new proposal was developed and referred.

## 3.2 SOILS AND LANDFORMS

### 3.2.1 Structural Integrity of Bund Walls given Storm Surge Potential and Geotechnically Unstable Base Material

The structural integrity of the bund walls was questioned given the storm surge potential and claims regarding the geotechnically unstable base material.

The bearing capacity of near surface supratidal area materials are low, as experienced at other solar salt operations and elsewhere in Australia where structures are constructed on these materials. The levees proposed for the project will be designed to be supported by the in situ material bearing capacity. This design method is consistent with other solar salt levee designs which have successfully withstood cyclonic impacts in Western Australia for the past 30 plus years. From all the geotechnical investigations conducted thus far for the project, we have found no evidence whatsoever that the near surface materials are "geotechnically unstable" as asserted in the submission. (ERMP Appendix 3 – Physical Environment of the Yannarie Salt Project Area, DC Blandford & Assoc/Oceanica 2005; Appendix 8 – Surface Hydrology for the Yannarie Salt Project, PB 2006)

Structural integrity has also been addressed in the Response to Submissions (First Public Review) section 4.14.1.3

### 3.2.2 Structural Integrity of Bunds given Use of Hypersaline Soils

It was submitted that seepage losses of up to 25% could be expected if the proponent used locally sourced material for construction due to potential physical changes in hypersaline soils on excavation and oxidation.

The project will use clay sourced from claypans located in the hinterland as detailed in the Modified Proposal document Appendix 2, (Straits, 2008) not from the saltflat. The ERMP Appendix 3 (DC Blandford & Associates / Oceanica 2005) includes soil and profile description for inspection site Y7 – hinterland claypan, (Figure 4.1) and in detail (Figure 5.3). This site specific data gives a soil salinity reading of 1817mg/kg TDS and a pH of 8.1. Consequently, the project will not be using hypersaline soils and the suggested chemical and physical changes to the structural integrity of the bunds will not occur.

### 3.2.3 Lack of Understanding of Stratigraphy of Supratidal Flat and Fatal Flaws in Understanding Hydrology

It was claimed that the proponent had a lack of understanding of the stratigraphy and the hydrology of the tidal flat.

No new information has been provided in relation to this assertion, particularly in light of the additional hydrogeological investigations and drilling programme undertaken by the proponent. This issue has been addressed in the Response to Submissions (First Public Review), section 4.2.4 (Straits 2008a)

The original hydrogeological assumptions have been verified by the additional drilling programme and the Department of Water (DoW) have observed after assessment of the drilling results that;

- *"The drilling indicates that the subsurface clay zone extends for 5m or more, is generally above water table and these zones have very low permeability, so there is unlikely to be significant vertical flux of brine." (DoW, 2008)*

It should be noted that the drilling programme encountered a minimum of 6m of penetration into the continuous clay layer, rather than 5m, and this ranged up to 13.5m of penetration without breaking through the clay layer. At two sites where the thickness of the clay layer was able to be confirmed it was 11m and 10.6m thick respectively (PB, 2008).

### 3.2.4 Stratigraphy shows Presence of "Preferred Aquifer Conduits" sufficient to act as preferred Seepage Layers

Concerns were raised over the potential for seepage from the ponds through what were described as "preferred aquifer conduits."

The results from the drilling programme on the supratidal flats of the project area do not show "preferred aquifer conduits" as alleged (PB 2008). Contrary to the assertion made, the low permeable marine and terrestrial sediments of the surficial aquifer contain clayey silts. Further, the surficial aquifer is underlain by a very low permeability sedimentary sequence comprising plastic, red brown clay and silty clay which was identified in all bores drilled on the supratidal flats (PB 2008)

This view is supported by the DoW submission which noted:

- *"The drilling indicates that the subsurface clay zone extends for 5m or more, is generally above water table and these zones have very low permeability, so there is unlikely to be significant vertical flux of brine."* (DoW, 2008)

It should be noted that the drilling programme identified the minimum continuous thickness of the clay layer at 6m in the investigation areas (PB 2008).

### 3.2.5 Limestones Intersected by Drilling Programme Translate to a "Substantial Porous and Permeable Aquifer"

It was claimed that the additional drilling results showed the presence of a porous and permeable aquifer.

No such "substantial porous and permeable aquifer" was encountered during the additional drilling programme on the supratidal flats (PB 2008) and no data is provided to support this claim. Analysis of the drilling results suggests there is unlikely to be any significant vertical flux of brines due to the very low permeabilities of the soils as supported by the submissions from the DoW (DoW, 2008) and referenced in section 3.2.4 and 3.2.3.

No karstic (porous) limestone was encountered in the drilling programme and the cemented calcarenite found at Hope Point was also not porous (PB2008).

### 3.2.6 Information on the Permeability of the Surficial Sediments is Unsatisfactory. Of Fourteen Samples, 7 are focused on Fine Grained Material. The Bores Presented Show a Predominance of Sandy, Limestone and Gravelly Materials. These are the materials that should be focused on

Appendix A of the hydrogeological investigations (PB, 2008) provides results for a total of 21 drill holes, of which 6 were drilled on mainland remnants, 8 were drilled on the supratidal flats, 6 were drilled at Hope Point and 1 was drilled at Wilderness island. The results do not show a "predominance of sandy, limestone and gravelly materials" across the supratidal flats where the ponds will be located which is where permeability issues are most important.

The hydrogeological investigations describe a surficial aquifer encountered on the supratidal flats generally comprised of clayey sands, silty clays and sands underlaid by clays (PB, 2008).

### 3.2.7 The details of the Stratigraphic Relationship of the Salt Flats to the Mangrove and Mid Tidal is Missing. This is required to Predict and Manage Groundwater Hydrodynamics

Concerns were raised that vital investigations regarding the stratigraphy of the salt flats were incomplete and hence the hydrodynamics of this area were not fully understood.

Due to the potential for significant environmental damage related to getting a drill rig into the mangrove and mid tidal areas this was not attempted. However, Figure 9 of the report (PB 2008) shows the locations of previous hand auger hydrogeological investigations (PB 2005) which occur closer to the mangrove and mid tidal region. These hand auger results have been used to compile the generalized stratigraphic representation of the project area. This is considered sufficient information to enable adequate and practical management and monitoring to be applied to this aspect in this area.

### 3.2.8 Inadequate Assessment and Understanding of Relationship between 0.8m Hydraulic Head and Seepage through "Sand and Limestone Aquifers"

A concern was raised that the hydraulic head of the ponds and the porous aquifer beneath would combine to facilitate seepage losses.

The results of the drilling programme undertaken on the supratidal flats does not show any permeable *"sand and limestone aquifer"*. The drilling results have been reviewed by the DoW which found; *"The drilling indicates that the subsurface clay zone extends for 5m or more, is generally above water table and these zones have very low permeability, so there is unlikely to be significant vertical flux of brines."* (DoW, 2008) The drilling report (PB 2008) found that the sediments of the surficial aquifer had a measured low permeability ranging from $10^{-6}$m/s to $10^{-9}$m/s.

### 3.2.9 The report "Hydrogeological Investigation of Supratidal Flats" does not Identify Aquifers, (except as "surficial aquifer"), and does not address Complexity and the Complex Types of Pathways that will develop

A concern was raised that the additional investigations failed to identify the full range of aquifers and the pathways between them.

The hydrogeological investigation identified 2 aquifers; a surficial aquifer and a deeper aquifer separated by a clay layer greater than 6m thick (PB, 2008). As explained in section 3.2.8, the low permeability of the surficial aquifer sediments will likely inhibit the flow of saline solution through to the deeper aquifer.

### 3.2.10 It is difficult to ascertain the right Intended Figure for the Total Volume of Limestone to be Extracted from the Barge Harbour

The concern was raised in a submission that the required volume of limestone to be extracted from the barge harbour was not identifiable.

The limestone required for the project is intended to be extracted from the barge harbour, barge channel and transition excavation zone (Straits, 2008b).

In Table 2-7 of the Modified Proposal document (Straits 2008b), the transition land excavation volume is given as 10,000$m^3$. However, as indicated in Appendix 4 (Straits 2008b), this figure should be 85,000$m^3$.

Table 2-5 of the Modified Proposal document (Straits 2008b) has been found to include an error in the calculation of the volume of limestone basecourse material require for 'other infrastructure' which is given as 1,350,000m3 when this should read approximately 1,250,000. Hence the total volume of limestone basecourse material (small rock, fines and sediments) is 1,390,000m3 and in combination with the required armour material the total estimated volume of armour and limestone basecourse required is 1,965,000$m^3$.

### 3.2.11 The required Quantities of Limestone Armour are not Evidently Available from Barge Harbour/Barge Channel

Concern was raised that it was not apparent that the required quantity of limestone armour would be available from the barge harbour and barge channel.

There may be some confusion between the total required limestone material (basecourse and armour) and the assumption that all of this is rock armour quality. It should also be noted that limestone building material includes calcarenite and white hard coral limestone.

Site observations and preliminary investigations at Hope Point have provided Straits with an expectation that the required volumes of rock armour (575,000$m^3$) will be available from the barge harbour and nearshore barge channel. Investigation drilling from the barge harbour area shows that bore hole YMB03 contains a 0.9m band of well cemented calcarenite. Bore hole YMB04 contains a 3.1m band of very well cemented calcarenite. Bore hole YMB05 contains a 0.4m band of very well cemented limestone and a 3.7m band of very well cemented calcarenite. Bore hole YMB06 contains 0.7m of white hard coral limestone and 2.1m of very well cemented calcarenite. The nearshore limestone reef platform immediately adjacent to Hope Point within the designated barge channel will also provide an opportunity to excavate rock armour for use in the project.

On the basis of the drilling results from the barge harbour area, along with the site observations, Straits is confident that the required 575,000m$^3$ of armour will be available from the total excavation area.

## 3.3 GROUNDWATER

### 3.3.1 Impacts related to Salt Flat Conduits of Brine to the Ocean and to Deeper Karst Aquifers (Regional Water Supply Significance)

Concern was raised that the ponds would seep into deeper aquifers and contaminate a possible regional water supply.

The additional drilling programme conducted on the salt flats provided conclusive evidence in relation to the absence of freshwater aquifers and the DoW have observed after assessment of the drilling results (DoW, 2008) that;

- *"The drilling indicates that the subsurface clay zone extends for 5m or more, is generally above water table and these zones have very low permeability, so there is unlikely to be significant vertical flux of brine."*
- *"No fresh or brackish aquifers were identified in drilling so there is no freshwater resource to protect for the environment or other users."*

This issue was also addressed in the Response to Submissions (First Public Review) section 4.3.2. (Straits, 2008a)

### 3.3.2 Uncertainty Over Hydrogeological Model and Potential for Long Term Subsurface Discharge of Highly Saline Groundwater

The additional investigations referred to in the report; Hydrogeological Investigations of Supratidal Flats, Yannarie Solar Project (PB 2008), have provided confirmation of the general hydrological model used for the Yannarie Solar Project. With respect to the concerns raised in relation to subsurface discharge of highly saline water, the hydrological investigations (PB 2008) found that a hypersaline surficial aquifer existed across the salt flats between 2.6m and 5.0m thick, of low permeability marine and terrestrial sediments (clayey silts and silty sands). This surficial aquifer is underlaid by a clay layer greater than 6m thick which is generally above the water table, and has very low permeability.

Therefore the discharge of highly saline water through the clay layers is not supported by the investigations.

## 3.4 SURFACE WATER

### 3.4.1 Alteration of Surface Water Flows remain, despite Reduction in the Size of the Proposed Salt Field and the Lack of Redistribution of the Surface Water Flows around the Salt Ponds would have an Impact on the Local Hydrology

It was submitted that despite the changes to the proposed project, there would still be alterations of surface water flows due to the location of the ponds and it was uncertain how Straits would ensure minimal impacts to the environment, particularly without redistribution of surface water flows.

Additional investigations on the hydrogeology of the project area has been undertaken and made publicly available (PB 2008). The results of these investigations were assessed by the DoW which observed that:

- *"The reduced project footprint will allow outflows from Rouse Creek and Yannarie River, across the flats to the sea, reducing the impacts on algal mats and mangrove communities and allow more natural hydrology away from ponds."* (DoW 2008)

The issue of potential changes to surface hydrology has also been addressed in the ERMP Chapter 5, section 3.4 (Straits, 2006) and the Response to Submissions (First Public Review) in sections 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.8, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.3.11, 4.7.8 (Straits, 2008a)

### 3.4.2 Freshwater Discharges into Tidal Flats – in the Exmouth Area there will be Discharge of Waters along Preferred Pathways in a Tidal Flat System

Concern was raised that freshwater discharges onto the tidal flats would be along preferred pathways through the sedimentary sequence which would be blocked by the salt ponds..

The surficial aquifer encountered in all of the bores drilled on the supratidal flats was hypersaline. As observed by the DoW in relation to the drilling results; *"No fresh or brackish aquifers were identified in drilling, so there is no freshwater resource to protect for the environment or other users."* (DoW 2008)

The modified proposal also allows for outflows from Rouse Creek and the Yannarie River to flow across the flats to the sea, although such sustained flows are expected only as a result of the one in twenty year or greater events (Straits, 2006).

In the event of localized rainfall across the salt flat, as has occurred in the aftermath of Tropical Cyclone Pancho in 2008, this infiltration is likely to be rapidly salinised on contact with the stored salts and hypersaline water of the surficial aquifer (PB 2008). The lack of any visible incised flow channels across the salt flat (Oceanica, 2005) supports the contention of an absence of preferred pathways through the sedimentary sequence.

The very low permeabilities of the surficial aquifer sediments has also been detailed in the additional drilling investigations across the salt flats (PB, 2008). No evidence of 'preferred water flow pathways' was found in the surface sediments of the salt flat and no fresh or brackish aquifers were identified in drilling (PB 2008)

The issue of potential changes to surface hydrology has also been addressed in the ERMP Chapter 5, section 3.4 (Straits, 2006) and the Response to Submissions (First Public Review) in sections 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.8, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.3.11, 4.7.8 (Straits, 2008a)

### 3.4.3 Potential Impacts on Freshwater Soak at Hope Point

Concern was raised that the project would impact on what was claimed to be a freshwater soak at Hope Point, although no details on the location of the alleged freshwater soak were provided.

The results from the additional drilling programme (PB 2008) show no freshwater source on Hope Point. Site visits to Hope Point and biological surveys have not identified any freshwater soak or associated vegetation.. None of the flora species occurring in the project impact areas are known or putative phreatophytes (Gary Humphrey pers comm. 2007) Consequently, there is no physical or biological evidence of any freshwater soak at Hope Point.

### 3.4.4 Altered Hydrological Processes Potentially Causing Impacts on Productivity

Concern was raised that the proposal would inhibit surface water flows to the coast which would cause impacts on marine productivity.

The modified proposal now allows for outflows from the Rouse Creek and Yannarie River. This is confirmed by the DoW submissions which states; *"The reduced footprint will allow outflows from Rouse Creek and Yannarie River, across the flats to the sea, reducing the impacts on algal mats and mangrove communities and allow more natural hydrology away from the ponds."* (DoW 2008)

Evidence confirms that the productivity of the eastern side of the Exmouth Gulf is driven by the tidal system rather than the infrequent hinterland flows across the salt flats (Brunskill *et al* 2001), (Oceanica, 2005), (Straits 2006).

See also Sections 3.7.3, 3.7.4 and 3.7.5.

Concerns regarding impacts on hydrology have also been addressed in Response to Submissions (First Public Review), sections 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9 (Straits, 2008a).

## 3.5 TERRESTRIAL VEGETATION AND FLORA (EXCLUDING MANGROVES)

### 3.5.1 Significance of Area of Impact from Flood Backwaters behind Diversion Dam

Concern was raised that the potential significance of the impact of the flood backwaters behind the planned diversion dam was not adequately addressed.

The issue of the impacts related to flood backwaters is covered in some detail in the ERMP section 3.4.2, where it is explained that the footprint of inundation resulting from ponding upstream of the diversion weir for a 5 year ARI rainfall event or greater is approximately 151 ha within the Yanrey Land System which represents about 0.14% of this land system. (Straits 2006)

The ERMP section 4.3.2, 4.4.2 and 5.3.2 also cover this issue where it is explained that the longitudinal sand dune formations, interdune flats and claypans are typical landscape features in this locality and these are all represented on both the mainland and the supratidal salt flat mainland remnants (Straits 2006).

The *Additional Flora and Vegetation Assessment 2007* (Biota 2008) provides further assessment of the area subject to flood backwaters. This includes the following observations;

- "*Five vegetation types were recorded from the Project Area during the survey, representing three broad groupings based on landform position. None of these represent Threatened Ecological Communities (TECs), Priority Ecological Communities (PECs) or vegetation types that are of high conservation significance."*
- *"All of the vegetation types recorded in the survey were widespread inside the Project impact area and external to the Project Area as documented by the reference sites set up outside of impact areas."*
- *"The survey area contained a representation of vegetation types that were repeated through the repetition of landforms in the Project Area."*

The potential for permanent impact on the vegetation types from flood backwaters will be monitored through vegetation and flood monitoring. This monitoring will also provide further capacity to assess and respond to any potential flooding related impacts. Potential impacts are likely to depend on the retention time for the water in a high evaporation rate environment and the capacity for the vegetation to withstand and respond to any inundation. The vegetation types of the area potentially subject to inundation (Gilgai floodplains) are typically subject to flood events under natural conditions (Straits 2006).

However, the area of potential impact due to flood backwaters is very small and represented widely across the project area and the broader landscape.

### 3.5.2 Lack of Sampling of Summer and Winter Ephemeral Species due to Lack of Rain and hence inadequate Botanical Research

It was submitted that there was a lack of sampling of ephemeral species due to the lack of rain and hence there was insufficient botanical research on which to make an impact assessment.

Unfortunately, a lack of rain during the investigation period was always a significant possibility in such a dry environment. However, flora investigations from 2004, 2005 and 2007 did not identify any Declared Rare Flora (DRF). It is also considered that the vegetation types and landscapes within the potential project impact areas are repeated across the project area and more broadly through the adjacent region. Consequently, any potentially unidentified ephemeral species are not considered to be at particular risk.

The original flora and vegetation surveys were undertaken in August 2004. Follow up surveys of the mainland remnants were done in June 2005 following rainfall in the previous two months and at a time when numerous annual flora species were present (Biota 2005).

### 3.5.3 Lack of Management of Weeds

The updated Draft Terrestrial Vegetation Management Plan provides a detailed weed management strategy in section 4.1.1. This issue has also been addressed in the Response to Submissions (First Public Review) section 4.4.2. (Straits 2008a)

### 3.5.4 Additional Vegetation/Flora Information Not Comprehensive Enough and little known Vegetation Types should be Protected

The survey (Biota 2008) was designed and implemented to meet the requirements of EPA Guidance Statement No.51. The survey was also designed to compliment previous survey work. Vegetation/flora surveys have been carried out over the range of the project area, however due to the very low rainfall regime of the area it is difficult to coincide investigations with infrequent rainfall events. None of the vegetation types recorded in the project area are considered to be of high conservation significance. (Biota 2008). The vast majority of the project will take place on the bare salt flats and therefore have minimal impact on existing vegetation within the project area.

### 3.5.5 Vegetation Quadrats not Included in Diversion Dam Impact Area

The vegetation types located behind the diversion dam were mapped and presented in figure 5.1 (Biota 2008). The report (Biota 2008) mentions that; *"Bare claypans with fringing vegetation were also present in the study area, but no quadrats were set up in this habitat as there was sufficient representation of this vegetation type from the 2004 field survey."* (Page 28) The same report (Biota 2008) also states; *"The survey area contained a representation of vegetation types that were repeated through the repetition of landforms in the Project Area."* (Page 11).

### 3.5.6 Lack of Regional Data set for Terrestrial Vegetation Assessment should Result in Suspension of Project until this Information is Available

The survey was designed and implemented to meet the requirements of EPA Guidance Statement No.51. Unfortunately, botanical survey data collected by the Department of CALM (in 2004) from Giralia station, south of the Yannarie Solar project area is not available to include in a regional analysis (Biota 2008). In addition, the EPA Service Unit accepted that a regional dataset was not available for the conservation assessment and that the spatial scope for this exercise is therefore the immediate locality of the project (Biota 2008, page 13).

Floristic analysis was carried out using a combined dataset of 59 sites from the current study of the Yannarie Solar Project area (43 sites from the 2004 field survey and 16 sites from the 2007 field survey), together with 142 sites from five other survey areas in Pilbara coastal locations (Biota 2008).

These additional Pilbara sites included:

- 41 sites from the Dampier Salt project area 260 km northeast of the project area;
- 22 sites from the BHP Billiton Pilbara LNG Facility project in Onslow 70 km northeast of the project area;
- 44 sites from the BHP Billiton Pilbara LNG facility additional infrastructure areas about 70km northeast of the project area;
- 11 sites from the Onslow Strategic Industrial Area study about 70km northeast of the project area;
- 24 sites from the Port Hedland Salt Project area about 470km northeast of the project area.

It is considered that the additional Pilbara survey sites provided an understanding of the vegetation of the survey area in relation to the surrounding region. The vast majority of the project will take place on the bare salt flats and therefore have minimal impact on existing hinterland vegetation within the project area.

## 3.6 TERRESTRIAL FAUNA

### 3.6.1 Lack of any High Level of Certainty that the Risks to Subterranean Fauna can be Considered Low

The subterranean fauna habitat risk assessment was based on the requirements of EPA Guidance No. 54a (EPA 2007). This also conformed with the Scoping Document requirements. The subterranean fauna assessment was undertaken by a specialist consultant with recognized expertise in this field.

The results of the assessment show that there is a low potential for impact on any subterranean fauna as well as being a low likelihood of stygofauna occurrence and a low – moderate likelihood of troglofauna occurrence. (DC Blandford & Associates /Biota 2008)

### 3.6.2 Further Detailed and Comprehensive Research and Analysis should be Conducted in Relation to Subterranean Fauna

The subterranean fauna habitat risk assessment was based on the requirements of EPA Guidance No. 54a (EPA 2007). This also conformed with the project Scoping Document requirements.

The subterranean fauna habitat assessment (DC Blandford & Associates /Biota 2008) found:

- *"Low likelihood of stygofauna occurrence."* (page 23)
- *"Low likelihood of troglofauna occurrence for the majority of the project area, low-moderate at Hope Point."* (page 23)
- The project has an overall assessment for potential impact on subterranean fauna of *"low potential impact category."* (page 25)

The information gained from the investigation is sufficient to manage the low impact risks to any potential subterranean fauna.

## 3.7 BENTHIC PRIMARY PRODUCERS HABITAT (BPPH) AND ECOLOGICAL INTEGRITY

### 3.7.1 The Habitat Maps for Hope Point haven't been Overlain with the Zones of Effect and Influence for the Proposed New Channel. It is not certain how the Original Modeling used in the ERMP was Re-interrogated and whether an Understanding of Pressure Thresholds for Functional Benthic Groups was taken into account when Establishing Impact Zones

The channel alignment was reviewed and altered in order to improve the environmental outcome and conform with the EPA Guidance Statement 29; Benthic Primary Producer Habitat (BPPH) Protection for Western Australia's Marine Environment (EPA 2004a) for cumulative loss of benthic habitat.

The results from the modeling of the zone of reversible losses ($95^{th}$ %ile of background tubidity) and the zone of physiological stress ($80^{th}$ %ile of background turbidity) for the original channel alignment were considered by the specialist consultant to be indicative of the extent of these factors for the new channel alignment.

Consequently, while these zones were not remodeled for the new channel alignment, Table 5.3 of the report on the Hope Point Habitat mapping (Oceanica 2008) has included the estimated area of impact for both the zone of reversible losses and the zone of physiological stress extrapolated for the new channel alignment.

The work on revised habitat mapping at Hope Point primarily considered the impacts of the original channel alignment and demonstrated the environmental benefits that might be gained by realigning the channel so that direct BPPH losses would meet the EPA's objectives. Straits subsequently decided to revise the channel layout. The extent of the dredge plume was not re-assessed as the risk posed to BPPH was considered to be low due to the low volumes of material involved. The issue of risk to functional groups and 'pressure thresholds' was considered as follows.

There are essentially three functional groups in the area that may display sensitivity to increased suspended sediment concentrations: seagrass, algae and corals.

It is concluded by the specialist consultant, that of the habitats in the region potentially sensitive to dredging impact, corals will be of the most concern due to their presence during dredging period, longevity (such that any impacts are at risk of being long-term or permanent) and sensitivity to sedimentation and light.

Therefore coral health monitoring locations will be established at the sites adjacent to Hope Point. Monitoring will be designed to monitor the health of individual corals located at increasing distances to the north and south of the channel. The management objective for Straits will aim to have no loss of corals outside of the area of direct impact.

### 3.7.2 The Dredge Footprint will Predominately be in Sparse Seagrass Beds that are Potentially Habitat for Dugong and Marine Turtles

The area of 'sparse seagrass' to be directly lost to the proposed barge channel is 14.5ha or 0.3% of the habitat type in the management unit (Oceanica 2008). Oceanica also noted that previous work has shown that areas of dense seagrass will be predominately located to the south of Hope Point (Oceanica 2006). This is thought to be due to the lower wave energy south of Hope Point (Oceanica 2006).

The areas of greater dugong concentration south of Hope Point also coincides with the areas of more dense seagrass cover (Straits 2006). It is assumed that dense seagrass cover is more attractive as a food source than sparse seaggrass cover.

It is concluded (Oceanica 2008) that dredging at Hope Point does not pose long term threat to seagrasses or seagrass dependent species in the region due to:

- The lack of dense areas recorded on any survey near the channel.
- The only dense seagrass within the 'zone of influence' is located to the south-east, in ~1m water depth in the mouth of Hope Creek which is subject to strong tidal exchange. The combination of shallow water and regular flushing should ensure that the seagrass receives sufficient light even if turbidity is temporarily increased during dredging.
- That seagrass biomass will be at a minimum in winter months, which is when the dredging programme is scheduled (Loneragan et al 2003).
- That the local seagrass species are ephemeral and have been shown to recover rapidly following losses such as that recorded after Cyclone Vance (Loneragan et al 2003).

The report on the Hope Point Habitat Mapping (Oceanica 2008) also concludes:

*"Much of the area was found to consist of soft sediments, as previously found, with a sparse cover of seagrass observed in some areas. Due to the difficulty of detecting such a low seagrass cover within the aerial imagery, especially within deeper (>5m) and turbid waters, the majority of the area exhibiting soft sediments was mapped as 'sparse seagrass' habitat."* (Page 43)

Consequently, the area of sparse seagrass may have been overestimated relative to the area of soft sediment (bare habitat). Notwithstanding this possibility, there is no apparent risk to marine species, including dugongs and marine turtles, dependent on the seagrass habitat due to the dredging removal of 0.3% of sparse seagrass habitat within the Hope Point management unit.

### 3.7.3 Potential for Substantial Alteration to the Nitrogen Cycle and Input into the Gulf either by Releasing Nitrogen Concentrations as a more Rapid Rate or by Removing/Altering Mechanisms that Drive Nitrogen Release

Brunskill *et al* (2001), Oceanica (2005) and Straits (2006) have concluded that the eastern side of the Exmouth Gulf is a tidally driven system where the significant majority of nutrient inputs (including nitrogen) come from the inundation of the algal mats and this source is approximately two orders of magnitude greater than nutrients delivered from the hinterland.

Consequently, given that there is no scientifically published data to support a contrary view, there is not likely to be a "substantial" alteration to the nutrient cycle arising from any changes to the minor contribution of nutrient inputs from the hinterland (Brunskill *et al* 2001).

The issue of nutrient inputs and the relative importance of terrigenous inputs and those from the algal mats has already been addressed. (Response to Submissions (First Public Review) sections 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8).

This matter is further addressed in section 3.7.4.

The EPA has previously considered the matter of hinterland flows of nutrients versus tidally driven nutrient flows in relation to the Onslow Solar Salt project (EPA 1995). In this instance the EPA found in favour of the science presented by Onslow Salt which showed the tidally driven nutrient flows were significantly more important than any minor flow of nutrients from the hinterland.

Onslow Salt submitted that:

*"In the context of nutrient supply to the mangroves and algal mats, comparison of hinterland floodwater flows and tidal flux in Beadon Creek reveal that the quantity of nutrients supplied by tidal flushing of mangrove areas, together with the nitrogen fixing activities of associated algal mats, is likely to be many times (at least two orders of magnitude) the quantity of nutrients carried by sporadic floodwater flows. The input of mainland run-off to the area in question has been described in past documents produced by the EPA as being "…characterized by negligible influx of nutrient bearing waters from mainland rivers…" (Environmental Protection Authority, 1974). The periodic hinterland flow of water is therefore of little importance in satisfying the nutrient requirements of the mangrove or algal mat communities in Beadon Creek."* (Onslow Salt, 1995)

In response to the submission from Onslow Salt the EPA responded in Bulletin776 (EPA 1995); *"The EPA considers that the conclusions from the latest research, and observations from existing saltfield operations, support Onslow Salt's contention about the lack of influence of freshwater flood input on mangrove ecosystems."* (EPA 1995)

No new scientific propositions regarding the major contribution of nutrients to the Exmouth Gulf are known to have been published in the scientific literature since the publication of Bulletin 776 (EPA, 1995).

### 3.7.4 Reduced Nutrient Inputs Due to Disruption of Flow of Water across Salt Flats, Specifically the Loss of Exposure to Cyclonic Flow

A submission was made that claimed that sheet flow across Yannarie Flats during cyclones is likely to carry much larger nitrogen loads into Exmouth Gulf derived from the leaching of nitrogen stored within evaporates and shallow sediments in the area. It was claimed that if only 10% of this was leached by surface runoff in each cyclone event, about 3500 kg of N could be discharged into Exmouth Gulf which is replenished between cyclones by runoff from small rainfall events and dust fall out.

No data was provided in support of the assumptions or conclusions in the submission. The assumptions used in the submission regarding how much nitrogen is available in sediments and consequently how much could be leached from the salt flats in cyclone events are not based on(or supported by) the data made available in the report on the additional hydrogeological investigations (PB 2008).

Firstly, the submission appears to use a total nitrogen value in estimating nitrogen loads, however, not all nitrogen is available for mobilization. The second assumption is that nitrogen will flow through the surficial aquifer and discharge into the Gulf. However, the low permeabilities of the surficial aquifer do not readily facilitate such flows and the drilling programme did not encounter any 'channels' for the flow of water through the low permeability surficial aquifer.

The report assessment of the potential for nutrient and metal mobility within the surface soils and groundwater of the aquifer systems of the supratidal flats (PB 2008b), states; "*The differences in the observed relationships between nitrogen within the soil, leachate and groundwater samples highlights that natural variability of nitrogen speciation within the supratidal flats occurs, which may be due to different sources of nitrogen (e.g. decomposition of organic matter, concentration of inorganic N from seawater and possible mineralization reactions). However, there is too much variability within the current data to make generalized observations on the migration characteristics of nitrogen within the Yannarie supratidal flats."*

The Yannarie Solar ERMP (Straits 2006) has also identified that flows from the hinterland across the flats to the ocean are likely to occur only every twenty years. Localised rainfall on the flats can occur more frequently, however, this does not necessarily lead to 'sheet flow' across the flats, but rather pooling and evaporation of hypersaline waters. In addition, the soils in the catchment area beyond the mangrove/supratidal salt flat are ancient and nutrient poor and any freshwater inflows are unlikely to carry significant nutrient loads (Brunskill *et al* 2001, D.C Blandford & Associates and Oceanica 2005)

Further to the above and according to the draft paper by Lovelock *et al* (2007) provided as an attachment to the submission from MG Kailis, the algal mat is *"a significant store of carbon and other elements, particularly of Ca, Mg, S, N and P which are in high concentrations compared to the marine sediments (Brunskill et al 2001)."*

The very low permeabilities as well as the flat topography (Straits 2006) do not readily facilitate flows across the salt flats, unless these involve one in twenty year hinterland flows (Straits 2006). During localized rainfall events the water tends to pool across the salt flats.

However, the most significant source of nutrients into the Gulf system comes from the regular tidal flooding and ebbing across the algal mats and mangroves (Straits 2006). Brunskill *et al* (2001) concluded that the eastern side of the Exmouth Gulf is a tidally driven system where the significant majority of nutrient inputs (including nitrogen) come from the inundation of the algal mats and this source is approximately two orders of magnitude greater than nutrients delivered from the hinterland.

The project has carefully avoided any interference with the tidal system to maintain ecosystem processes and productivity.

### 3.7.5 Relative Importance of Terrigenous Inputs for Maintaining Biological Productivity

Reference is made in a submission to information provided in Lovelock *et al* (2008) which shows that the sediments of the region were found to have high levels of Fe and Al within the algal mats. It is claimed that these sediments show there is a significant terrestrial influence on the algal mat.

No evidence has been provided to support the notion that terrestrial inputs are important for maintaining biological productivity. The report on additional hydrogeological investigations (PB 2008b) showed that there were large concentrations of iron (Fe) and aluminium (Al) across the drilling sites over the supratidal flats and this was not associated with the presence or absence of algal mats. In any case, this does not alter any of the previously provided responses in relation to the relative importance of terrigenous inputs to the system and the relative importance of cyclonic events. See Response to Submissions (First Public Review) sections 4.7.8, 4.3.10.1, 4.3.10.2, 4.3.10.5.

The modified project (Straits 2008b) will allow outflows from Rouse Creek and Yannarie River across the salt flats to the algal mats and the sea.

### 3.7.6 The Proponent has Failed to Provide a Baseline Assessment of the Ecosystem Structure and Functions of the Intertidal Habitats that Occur within the Proposed Development Area

The ERMP has provided a baseline assessment of the intertidal ecosystem structure and function in Chapter 6 (Straits 2006).

Straits is co-funding a research project currently investigating the structure and functions of the intertidal habitats in the vicinity of the project area. However, the final results of this research are not required in order for an assumption to be made regarding the importance of the tidal function and contribution of the algal mats to Gulf productivity, based on existing research from a variety of sources and cited in the Yannarie Solar ERMP (Straits 2006).

Consequently, the Yannarie Solar project has been deliberately designed to minimise impacts on both mangroves and algal mats and maintain the existing tidal dynamics. In addition, the modified project has increased the setback of the major pond structures from the high water mark from an average setback of 40m to a minimum setback of 100 metres. This is designed to provide additional capacity for uninhibited tidal function.

### 3.7.7 Changes to Overland Flow Resulting in Reduced Deposition of Sediment and Associated Decline in Seagrass Abundance

A submission raised a concern that the project could lead to reduced deposition of sediment which could have an impact on seagrass abundance. No evidence was provided to support the notion that sediment loads are significant for seagrass productivity.

The modified proposal allows any potential hinterland discharge across the supratidal flats, as recognized in the DoW submission:

- *"The reduced project footprint will allow outflows from Rouse Creek and Yannarie River, across the flats to the sea, reducing the impacts on algal mats and mangrove communities and allow more natural hydrology away from ponds."* (DoW 2008)

Further to the above, a submission from the DEC makes comment on the issue of sediment flows to the Gulf;

*"More recently, overgrazing by introduced livestock in the catchment has probably caused increasing loads of sediment to be discharged to the Gulf and this may be having an adverse effect on benthic environments in particular."* (DEC, 2008)

Consequently, the modified project will allow outflows from the Rouse Creek and Yannarie River to flow across the salt flats to the sea, although it is not apparent that sediment loads are a significant benefit to seagrass productivity.

### 3.7.8 The Revised Proposal does not give a Sufficient Level of Comfort that there will not be Impacts on Nutrient Cycling Productivity in the Gulf

The project has been designed to avoid impacts on the ecosystem function of the project area. As the eastern side of the Gulf is a tidally driven system and the recognized major source of nutrient inputs come from the algal mats (Brunskill *et al* 2001), the project has minimized impacts on these areas.

The modified proposal involves increasing the setback from the algal mats (as indicator of high water mark) to a minimum of 100 metres. The modified proposal also allows hinterland outflows from Rouse Creek and Yannarie River across the flats to the sea, even though Straits has shown (Straits 2006) that such flows are not the most significant source of nutrients to the Gulf.

Western Australia has a long history of solar saltfields coexisting with fisheries operations including prawn trawling as well as, marine parks and world heritage areas. This occurs in Onslow, Dampier and Shark Bay where solar salt operations have been regularly monitored and found not to be having any significant environmental impacts (Onslow Salt, 1995; EPA 1999).

See also response to 3.15.4.

The issues regarding nutrient cycling and productivity have been addressed in the Response to Submissions (First Public Review) sections 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.6, 4.7.6.1, 4.7.6.2, 4.7.8

## 3.8 MARINE FAUNA

### 3.8.1 Management Plans provide No Conceivable Actions that could Realistically be taken to Protect Marine Wildlife once the Gulf has become another Industrial Port

The Draft Marine Management plan provides a range of actions to protect marine wildlife, including:

- Compulsory piloting of salt transport ships within the Gulf
- Designated shipping routes and anchorage sites.

The relevant actions within the Draft Marine Management Plan have been further refined to provide a more rigorous research based process to determine transit routes during the peak whale/calf period.

These management actions will include:

- Reduce as far as practicable shipping movements in the Gulf during the 4 week period of peak whale/calf activity (notionally 20 September to 17 October). The commencement of the 4 week peak period will be subject to consultation with the Centre for Whale Research (CWR).

- Establish and use designated routes and anchorage areas for salt transport ships and barge movements.

- Maintain a watch for sleeping or resting cow/calf pairs and maintain a 100m approach limit.

- Every bulk carrier in the Gulf will be under the control of a Straits engaged pilot who will board the vessel prior to it entering the Gulf.

- All vessels shall be restricted to a maximum speed of 10 knots within the Fish Habitat Protection Zone (this area contains the greatest concentration of dugongs)

- All salt loading vessels (ships, tugs and barges) operating in the Exmouth Gulf will have their speed restricted to less than 10 knots at all times, unless involved in an emergency such as a medical evacuation.

- All other vessels to be restricted to a maximum speed of 10 knots anywhere in the Gulf during the 4 week period of peak whale/calf activity (notionally between 20 September and 17 October).

- Results from the whale interaction research programme will be used to update the medium density area (75% P Contour Plot) from the time of project approval to project implementation.

- During the peak whale/calf period of activity, Straits will apply a buffer of 1.5km along the medium density area contour and all ship loading activities will be kept outside this buffered zone, where there is a safe, workable alternative (depth at greater than 13m)

- During the peak whale/calf period of activity, Straits will avoid completely the medium density P contour plot to be identified by CWR, where there is a safe, workable alternative (depth at greater than 13m).

If there are no safe transit options for ships which avoid completely the 75% P Contour Plot, Straits will be advised by the CWR (with the aid of a detailed risk assessment) on the least intrusive (least impact on whales) transit route operating at a further reduced speed of approximately 6 knots.

> *If the 75% P Contour Plot (medium density area) is to be transited during the peak whale/calf period, Straits will seek a common user policy from the various stakeholders as well as the WA Government in relation to ship/boat access, transit routes and speeds in the Gulf during the peak whale/calf period of activity. This will be done in consultation with DEC and CWR..*

- Straits will monitor the presence of humpback whales along the 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.

- Prepare and implement avoidance procedures for whale strikes in the Gulf, in consultation with the CWR.

The 5 year whale interaction research programme to be implemented in consultation with the CWR will be undertaken as detailed in the ERMP (page 6-132).

## 3.9 COMMERCIAL FISHING AND AQUACULTURE

### 3.9.1 International Precedent in Venezuela of Salt Ponds Causing a Serious Decline in Local Fisheries

This issue is not referenced or expounded upon to provide any reason why there has been a *"serious decline"* in local Venezuelan fisheries or what component of the salt production process was responsible. There is no evidence, nor any submissions, that local fisheries in close proximity to any West Australian salt ponds (e.g Onslow prawn fishery, Nickol Bay prawn fishery, Shark Bay prawn fishery) have been adversely affected by salt ponds, even where bitterns is discharged via tidal channels and creeks directly into the prawn nursery.

Western Australia has a long history in the design, assessment, construction and regulation of solar salt fields, including the managed discharge of bitterns into areas adjacent to a World Heritage Area (EPA, 1999), a future proposed Marine Park (EPA, 1990) and designated prawn nursery (EPA, 1995).

It is apparent from the various EPA assessments relating to salt field development, (EPA, 1990, 1995, 1999) that there is a lack of any significant environmental impact from current bitterns discharge management.

Onslow Salt has approval to discharge bitterns which flows into the Ashburton Nursery of the Onslow Prawn Managed Fishery. Despite the discharge of bitterns, this fishery experienced the highest catch of prawns ever recorded in 2003 at 193 tonnes (DoF 2004) and this was then exceeded for 2004 with a catch of 194 tonnes (DoF 2005). In both instances the majority of the prawn catch was comprised of tiger prawns and the explanation for the high tiger prawn catch was that it reflected "favourable environmental conditions" for this species (i.e an absence of destructive cyclonic activity) (DoF 2004/2005).

Therefore, Straits anticipates there will be no impact on local fisheries due to the presence of the Yannarie Solar Project

## 3.10 RECREATION AND TOURISM

### 3.10.1 Increased Recreational Use of the Eastern Side of the Gulf due to Improved Overland Access

The Response to Submissions (first public review) section 4.10.5 details the current low recreational use of the eastern side of the Gulf given proximity to other attractions such as Ningaloo Reef and the Muiron Islands. It is considered that even with improved road access around to the eastern side of the Gulf it is a long journey compared to these closer attractions. The road access will lead to the project area, which will be a designated mine site and therefore be inaccessible to the public.

### 3.10.2 Economic and Social Benefits to Exmouth Region are Low Relative to Tourism

The submission from Tourism WA identifies that the whole of the Gascoyne tourism industry is worth about $172 million pa. In comparison the project alone will generate an estimated $100 million per annum, with royalty payments of about $1M per year. The principle difference being that while tourism is seasonal, the Yannarie Solar project will be an all year round operation, providing long term, consistent employment security. The construction employment for the Yannarie Solar project is estimated to be about 100 personnel and the operational phase is expected to employ 75 people full time. These are not fly in fly out positions, but will be sourced from Exmouth and hence be based in the region.

The important point to note is that the Yannarie Solar project will not interfere with the Gascoyne tourism industry, and could potentially compliment this through fishing tours to the first concentration ponds (Straits 2006).

There is no evidence to suggest that the project will diminish the value of the existing tourism attractions of the region.

## 3.11 CULTURAL HERIATGE AND CONSERVATION VALUES

### 3.11.1 Impact of Loss of Exmouth Gulf East Wetland

A submission was made that further discussion was required in relation to the value and the impact of the loss of this Nationally Important Wetland which would be adversely impacted by the project. It was also requested that consideration be given to whether any changes to the wetland are consistent with EPA principles.

The ERMP makes reference (p. 6-22 and 6-23) to the listing of the east coast of the Exmouth Gulf in the Commonwealth Department of the Environment and Heritage's *A Directory of Important Wetlands in Australia.* It is noted that the listing is on the basis of the mangrove coast and intertidal area and is described as "An outstanding example of tidal wetland systems of low coast of north west Australia, with well developed tidal creeks, extensive mangrove swamps and broad saline coastal flats".

While the submission asserts that this major asset "will be adversely impacted by the project", there is no supporting information to explain this conclusion and in fact the modified proposal has significantly reduced the minor impacts on the natural assets which are the basis of the listing.

Consequently, the area of mangrove to be affected has been reduced from 5.4ha to 2ha, the area of algal mats to be affected has been reduced from 30.8ha to 17 ha and the area of salt flat to be constrained by salt ponds has been reduced from 411km$^2$ to 180km$^2$.

The Yannarie Solar proposal has been designed to protect the ecosystem function of the listed wetland, which is directly related to this being a tidally driven system (Brunskill *et al* 2001) and this has been further enhanced by the significant increase in setback from the high water mark from an average of 40metres to a minimum of 100metres.

There is no anticipated loss of ecosystem function or value of the wetland due to the project.

This issue is also addressed in the Response to Submissions (First Public Review) sections 4.11.1.2, 4.11.3.(Straits 2008a)

### 3.11.2 Pristine Nature of the Area and Low Incidence of Invasive Species should be Considered as Values

The ERMP has provided consideration of the regional context for the project, including the important ecosystem function of the wetland system and the productivity of the Gulf, and designed the project to minimise the impacts on these values. (Straits 2006)

The project area is adjacent to pastoral leases and the fauna surveys (Biota 2005) for the project included 5 species of introduced mammals, including sheep, cattle, foxes, cats and mice. During the 2007 vegetation survey, 13 of the 16 sites assessed contained introduced Buffel Grass (weed species).

The submission from the DEC (DEC, 2008) also makes the observation; *"More recently, overgrazing by introduced livestock in the catchment has probably caused increasing loads of sediment to be discharged to the gulf and this may be having an adverse effect on benthic environments in particular."*

Straits contends that there is evidence suggesting that the project area is not pristine as well as the presence of invasive species. However, the Yannarie Solar Project has been designed to treat the project area as having high conservation values and to avoid or minimize potential environmental impacts.

### 3.11.3 Impacts to Designated 'High Reservation Priority Ecosystems' should be avoided

A concern was raised that any potential impacts to vegetation designated in the survey (Biota 2008) as high reservation priority ecosystems should be avoided.

All potential environmental impacts are first assessed for the ability to avoid the impact altogether. Consequently, wherever the project can alleviate direct environmental impacts through alternative design, these opportunities will be and have been taken.

'High reservation priority' does not reflect conservation status, but relative representation in the reserve system which relates to Departmental priorities. The high reservation priority systems are not restricted to the project area and are considered to have only moderate conservation significance based on the PATN analysis (Biota 2008).

## 3.12 COASTAL PROCESSES, SEA LEVEL RISE, MAJOR STORMS, CLIMATE CHANGE

### 3.12.1 The Consequences of Sea Level Rise have not been Adequately Addressed, particularly in Relation to Structural Integrity of Levees

The issue of sea level rise has been addressed in the Response to Submissions (first public review) (Straits 2008a) sections 4.11.2, 4.14.1, 4.14.1.1, 4.14.1.2, 4.14.3.2, 4.14.3; 4.14.3.1. The modified proposal has also increased the setback of the seawater ponds from the high water mark from an average of 40m to a minimum of 100m.

As part of the Response to Submissions Straits has provided modeling of three sea level rise scenarios of 30cm, 50cm and 100cm. The Yannarie Solar project has used the Bruun Rule to estimate possible sea level rise, although this is considered to be overly conservative. It is worth noting that a submission from the DEC (DEC 2008) stated that;

*"..the rate of tectonic uplift in the area could be of the order of about 0.2mm/year. However, the Department of Planning and Infrastructure Ningaloo Coastal Strategy document indicates that the rate of sea level rise (measured in Carnarvon) is now comparable with this tectonic uplift rate, and could exceed 0.35 mm/year within the next few decades if predictions by the International Panel on Climate Change are correct."*

Straits has interpreted this submission to mean that the net sea level rise could be 0.15mm/year within the next few decades. This equates to 15mm in the next 100 years. On this basis, the Yannarie Solar proposal has grossly overestimated the potential for sea level rise.

With respect to any increase in sea level resulting in more regular inundation of the supratidal flat up to the salt pond levee walls, the levee walls will be constructed according to the appropriate Australian Standards. These levees are designed to contain seawater and are built with a largely impermeable clay core and are protected by rock armour. Such levees are used to separate seawater in adjoining ponds to a depth of approximately 0.5m. Consequently, these levees are designed to withstand any structural challenge from water on both sides of the wall as would be experienced in the case of sea level rise inundating the salt flats.

### 3.12.2 Disturbance of Coastal Sediments in the Surficial Aquifer could Potentially Lead to Discharge of Metals such as Iron and Aluminium (also Boron and Molybdenum) to Levels that could Cause Harm to Prawn and Fish Nurseries

Further to the report on the Hydrogeological Investigation of Supratidal Flats, Yannarie Solar Project (PB 2008a), Straits has also been provided with an additional report on the hydrogeochemistry of the supratidal flats (PB 2008b) which includes the results of groundwater, soils and ASLP leachate chemistry to assess the potential likelihood of migration of metals from soils if the soils were disturbed.

The results of this investigation (PB 2008b) showed that:

- The seawater at Hope Point contains concentrations of trace metals that exceed the DEC trigger values;
- The naturally occurring groundwater has concentrations of Lead (Pb), Chromium (Cr), Copper (Cu), and Zinc (Zn) that exceed the DEC trigger values.
- There is a high degree of variance in the nitrogen concentrations observed within the groundwater.

The DEC Assessment Criteria (DEC 2003) states; *"In some circumstances higher EIL values may be acceptable for arsenic, cobalt, chromium, copper, nickel, lead and zinc in areas where soils naturally have high background concentrations of these substances."*

The report (PB 2008b) observes that; "*In general the dominance of silt and clay particles within the upper aquifer (as qualitatively determined during the 2007 PB field investigation) coupled with the large concentrations of Fe and Al (Brunskill et al 2001, PB 2007) indicate that there will likely be a relatively high natural attenuation capacity of the aquifer system and therefore a low potential for the migration of trace elements within the surficial aquifer. Further, the pH and oxidation reduction potential (ORP) characteristics of the groundwater are representative of normal shallow groundwater (i.e slightly reducing and mildly oxidizing), under which no exaggerated chemical weathering (especially associated with de-adsorption of elements from ionic surfaces) is likely to occur."*

It is clear from the report on the hydrogeochemistry of the supratidal flats (PB, 2008b) that the impermeable nature of the soil and aquifer system across the supratidal flats makes it likely that metal mobility is low within the soil and groundwater system.

Further to the low likelihood of any metal mobility, the naturally occurring background levels of trace metals in the seawater at Hope Point and the groundwater (PB, 2008b) supports the concept that the marine flora and fauna have evolved in accordance to these concentrations

### 3.12.3 A Sea Level Rise of between 35 and 140cm this Century will Prevent Redistribution of Algal Mats and Mangroves

Sea level rise is covered in the Response to Submissions (First Public Review) (Straits 2008), section 4.11.2, 4.14.1, 4.14.1.1, 4.14.1.2, 4.14.3.2, 4.14.3; 4.14.3.1

Additional modeling has been provided (Straits 2008) in relation to the redistribution of mangroves and algal mats under 3 scenarios of sea level rise, including 0.3m, 0.5m and 1m. This modeling shows that redistribution of algal mat is not limited by the proposed Yannarie Solar project and under scenarios of sea level rise there will be a significant net increase in mangrove distribution.

Further to the above, the submission from the DEC (DEC, 2008), makes the point that:

*"..the rate of tectonic uplift in the area could be of the order of about 0.2mm/year. However, the Department of Planning and Infrastructure Ningaloo Coastal Strategy document indicates that the rate of sea level rise (measured in Carnarvon) is now comparable with this tectonic uplift rate, and could exceed 0.35 mm/year within the next few decades if predictions by the International Panel on Climate Change are correct."*

Straits interpretation from this submission is the net sea level rise could be 0.15mm/year within the next few decades. This equates to a rate of 15mm in the next 100 years.

The modified proposal has included a significant increase in setback from the high water mark for the project from an average of 40m to a minimum of 100metres.

Straits is confident that the modified proposal will not prevent redistribution of algal mat and mangroves from any likely sea level rise.

## 3.13 CLOSURE AND REHABILITATION

### 3.13.1 Lack of Decommissioning Plan and Inability to Remediate Solar Salt Pond Operation

A Preliminary Closure Plan has been prepared and provides strategies for 3 closure scenarios. The closure plan was available for public review. Closure strategies will depend on the proposed end land use and whether the infrastructure (such as ponds) can have an ongoing commercial use.

Further to the above, this issue was addressed in the Response to Submissions (First Public Review) (Straits 2008), section 4.15.

## 3.14 SUSTAINABILITY

### 3.14.1 The reduced Yannarie Solar Project will return only Relatively Small Economic and Social Benefits

The modified Yannarie Solar project will employ 100 people during construction and about 75 full time permanent employees. This is a year round operation, rather than being seasonal like the Gulf prawn fishery or tourism. The estimated revenue is about $100M annually compared to about $10 - $15M per annum for the Gulf fishery (Oceanica 2005b).

Straits therefore believes the project will provide significant economic and social benefits to Exmouth.

## 3.15 BITTERNS

### 3.15.1 The Incorrect Background Data was Used to Determine whether Bitterns Discharge and Mixing would Result in Salinity and Magnesium Concentrations significantly above Background Levels

The modeling of bitterns discharge from Hope Point was provided, on request, as indicative of one particular means by which bitterns could be diluted and discharged. The background data used (from Deans Creek) is indicative of the hypersaline water being continuously discharged from the tidal creeks in the vicinity of Hope Point. It should be noted that immediately south of Hope Point is Hope Creek which similarly discharges hypersaline water out and around the Hope Point headland due to the prevailing winds and action of the tidal cycles (APASA 2005a & b).

Further to the modeling provided in the report on Bitterns discharge modeling (APASA 2007), advice was provided on the level of dilution required to meet the 95$^{th}$ %ile of background magnesium concentrations at the harbour entrance.

While the modeling of bitterns discharge at Hope Point was provided as a possible discharge option, this is not the only option available based on the existing approved practice for salt fields in WA.

### 3.15.2 The Predicted Magnesium and Salinity Concentrations were found to be above Background Levels at some Sites and the Exceedance of Background Levels is likely to be much Higher and more Frequent than Predicted

The advice provided in respect to dilution levels for bitterns C (APASA 2007) showed that the background concentrations of magnesium can be achieved at the harbour entrance. Consequently, with the recommended increase in dilution levels for the bitterns C it is likely that background levels of predicted magnesium and salinity concentrations will be much lower than shown in the model depictions.

While the modeling of bitterns discharge at Hope Point was provided as a possible discharge option, this is not the only option available based on the existing approved practice for salt fields in WA.

### 3.15.3 Concerns over Potential for Bitterns Management Area to Sustain Breaches in Levee Walls and Overtopping

The levee walls will be constructed according to the appropriate Australian Standards. These levees are designed to contain seawater and are built with a largely impermeable clay core and are protected by rock armour. The levees are designed to withstand wave run up from storm events, but will accommodate overtopping for a 1 in 50 year event, although they are designed to maintain structural integrity for more severe storm events, such as the 1 in 100 year event. Existing salt ponds in WA provide an example of the capacity for structural integrity under storm events of properly constructed levees.

The bitterns management area for the Yannarie Solar proposal is located about 5kms from the coast and behind significant remnant land masses which provide a natural added storm protection.

### 3.15.4 Potential for Major Adverse Effects on Conservation Values of Exmouth Gulf from Possible Bitterns Discharge

The Yannarie Solar proposal does not seek approval to discharge bitterns. However, the concern raised also refers to inadvertent release of bitterns, although the structural integrity of the bitterns ponds is covered in 3.15.3 above.

Western Australia has a long history in the design, assessment, construction and regulation of solar salt fields, including the managed discharge of bitterns into areas adjacent to a World Heritage Area (EPA, 1999), a future proposed Marine Park (EPA, 1990) and designated prawn nursery (EPA, 1995).

It is apparent from the various EPA assessments relating to salt field development, (EPA, 1990, 1995, 1999) that there is a lack of any significant environmental impact from current bitterns discharge management.

The bitterns management area for the Yannarie Solar proposal is located about 5kms from the coast and behind significant remnant land masses to provide additional storm protection.

### 3.15.5 The Frequency, Duration and Intensity of Exceedance Events has not been Discussed or Modeled, nor has this necessary Information been Translated into a Discussion on Ecological Consequence

The modeling of discharge of bitterns C has been provided at the request of the EPA even though this is not a component of the Yannarie Solar proposal and despite the fact that Straits is confident of not requiring a referral to the EPA for consideration of a discharge option.

The indicative modeling involved the discharge of bitterns C from Hope Point. However, if discharge was to be further considered there would be detailed consideration of alternate discharge options, including those already approved by the EPA and regulated by the DEC at existing salt fields in WA.

Further to this, the most stringent assessment of any discharge option would also likely involve ecotoxicity testing to provide assurance of the environmental safety of such an option. Ecotoxicity testing for bitterns C was not undertaken, on agreement with the EPA, due to the lack of scientific integrity of such a test without a bitterns C product.

### 3.15.6 Bitterns Discharge Modeling: Potential for Flooding Tides and Prevailing Winds to Force Emergent Plume Back onto Coast, Drift North and Remain Inshore. How would Straits manage the possibility of the Plume Not Mixing Effectively

The modeling of discharge of bitterns C has been provided at the request of the EPA even though this is not a component of the Yannarie Solar proposal and despite the fact that Straits is confident of not requiring a referral to the EPA for consideration of a discharge option.

The advice provided in respect to dilution levels for bitterns C (APASA 2007) showed that the background concentrations of magnesium can be achieved at the harbour entrance. Consequently, with the recommended increase in dilution levels for the bitterns C it is likely that background levels of predicted magnesium and salinity concentrations will be much lower than shown in the model depictions.

The indicative modeling involved the discharge of bitterns C from Hope Point. However, if discharge was to be proposed there would be detailed consideration of alternate discharge options including those already approved by the EPA and regulated by the DEC at existing salt fields in WA. (EPA 1997; EPA 1999)

Straits is confident that effective mixing of the bitterns C with the dilution seawater prior to discharge will help ensure that the plume will disperse.

### 3.15.7 Bitterns Discharge Modeling: Potential for Water Stratification Due to Formation of Halocline that Acts as Barrier to Water Mixing

The advice provided in respect to dilution levels for bitterns C (APASA 2007) showed that the background concentrations of magnesium can be achieved at the harbour entrance. Consequently, with the recommended increase in dilution levels for the bitterns C it is likely that background levels of predicted magnesium and salinity concentrations will be much lower than shown in the model depictions.

Straits would investigate a range of options for physical mixing and dilution of bitterns if this option was ever required. Straits is confident that engineering solutions can be applied to the issue of adequately mixing bitterns prior to discharge if this option was ever required.

### 3.15.8 Bitterns Discharge Modeling: Assumption that the Discharge would have the same Temperature as the Receiving Water due to Rapid Rate of Throughput and Mixing Ration of Ambient Water to Bitterns. No Supporting Information

Based on assumptions of temperature and volume for bitterns C and mixing sea water in the table below, there is about a 0.5 degree temperature difference between the mixed discharge water and the receiving waters of the Gulf.

| | Bitterns C | Mixing sea water | Mixed discharge water | Units |
|---|---|---|---|---|
| **Temperature** | 65 | 15 | 15.4 | Degrees C |
| **Volume** | 1,125,000 | 125,000,000 | 126,125,000 | m3 |

The naturally occurring daily background temperature range of Gulf water will be several degrees. Therefore the discharge temperature will be almost undetectable within the background range.

The volume ratio of bitterns C to mixing sea water means that irrespective of the temperature of bitterns C, the mixed discharge condition will always approximate to the temperature of the mixing water (always within 0.5 degrees).

### 3.15.9 Toxic Effects of Bitterns on Aquatic and Wading Birds

This issue is addressed in the Response to Submissions (First Public Review) (Straits 2006) section 4.5.4.1

While existing salt fields in WA have recorded significant numbers of migratory and wading birds (Dampier Salt Limited 2006) being attracted to the productive pond habitat, there is not a published record of regular or even occasional toxic effects from bitterns contact on aquatic birds in Western Australia.

However, Straits would maintain a record of any instances of toxic impacts on aquatic birds and consult with the DEC in relation to the evaluation of management options if these were required.

### 3.15.10 Toxic Effects of Bitterns Discharge (Deliberate or Accidental) on Marine Ecosystems

Concern was raised regarding the potential for toxic impacts on the marine ecosystem if there was deliberate or accidental bitterns discharge.

Firstly, no approval is sought for the discharge of bitterns. Secondly, the bitterns management area is located about 5 kms from the coast and behind significant remnant landmasses which provide a physical barrier to storm events hence minimizing opportunities for accidental discharge.

Western Australia has a long history in the design, assessment, construction and regulation of solar salt fields, including the managed discharge of bitterns into areas adjacent to a World Heritage Area (EPA, 1999), future proposed Marine Park (EPA, 1990) and designated prawn nursery (EPA, 1995).

It is apparent from the various EPA assessments relating to salt field development, (EPA, 1990, 1995, 1999) that there is a lack of any significant environmental impact from current bitterns discharge management.

# 4. SUBMISSIONS AND ISSUES

The full list of submitters and the issues raised by each are set out in Table 4-1.

Cross references have been provided against issues raised in Table 4-1 to indicate where they have been addressed in Section 3 of this report.

**Table 4-1 Submissions and Issues Raised in Additional Public Comment Period**

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 1 | Department of Environment and Conservation (DEC) – Pilbara Region. | <u>New Issues Raised</u><br>• Bitterns discharge modeling: potential for flooding tides and prevailing winds to force emergent plume onto coast (Section 3.15.6)<br>• Bitterns discharge modeling: potential for water stratification (Section 3.15.7)<br>• Bitterns discharge modeling: assumption of discharge temperature (Section 3.15.8)<br>• Surface water flow alterations and effort to minimize impacts (Section 3.4.1, 3.4.2)<br><u>Issues Already Addressed</u><br>• Changes to groundwater salinity due to seepage of pond water with lower salinity than receiving environment (Response to Submissions, First Public Review, 4.7.3.1) |
| 2 | DEC Environmental Management | <u>New Issues Raised</u><br>• Reduced nutrient inputs due to loss of exposure to cyclonic sheet flow (Section 3.7.4)<br>• International precedent from Venezuela of salt ponds causing decline in local fisheries (Section 3.9.1)<br>• Structural integrity of bund walls given geotechnically unstable base material (Section 3.2.1)<br>• Structural integrity of bund walls given use of hypersaline soils (Section 3.2.2)<br>• Toxic effects of bitterns on aquatic and wading birds (Section 3.15.9)<br>• Toxic effects of bitterns discharge on marine ecosystems (Section 3.15.10) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 3 | DEC | • Hope Point habitat maps not overlaid with zones of effect and influence (Section 3.7.1)<br>• Dredge footprint impact on sparse seagrass (Section 3.7.2)<br>• Incorrect background data for bitterns discharge modeling (Section 3.15.1)<br>• Predicted magnesium and salinity concentrations were found to be above background levels and exceedance likely to be much higher and more frequent than predicted (Section 3.15.2)<br>• Concerns over potential for bitterns management area to sustain breaches in levee walls and overtopping (Section 3.15.3)<br>• Potential for major adverse effects on conservation values of Exmouth Gulf from possible bitterns discharge (Section3.15.4)<br>• Frequency, duration and intensity of exceedance events not translated into ecological consequences (Section 3.15.5)<br>• Consequences of sea level rise not adequately addressed, particularly in relation to structural integrity of levees (Section 3.12.1)<br>• Disturbance of coastal sediments in the surficial aquifer leading to discharge of metals to levels that could cause harm to prawn and fish nurseries (Section 3.12.2)<br>• Potential for alteration to the nitrogen cycle either by releasing nitrogen at a more rapid rate or by altering mechanisms that drive nitrogen release (Section 3.7.3)<br>• Alteration of surface water flows despite reduction in the size of the proposal (Section3.4.1)<br>• Lack of any high level of certainty that risks to subterranean fauna can be considered low (Section 3.6.1)<br><br><u>Issues Already Addressed</u><br><br>• Potential impacts to claypan communities (Response to Submissions Volume 1, Section 4.2.3)<br>• All issues previously raised in first public consultation process (Response to Submissions, First Public Review, Table 5-1) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 4 | Department of Water (DoW) | • Impact of loss of Exmouth Gulf East Wetland (Section 3.11.1) |
| 5 | Marine Parks and Reserves Authority | <u>Issues Already Addressed</u><br>• Impact on mangrove, seagrass and algal communities (Response to Submissions, First Public Review, 4.7.2, 4.7.3, 4.7.3.1, 4.7.4, 4.7.6, 4.7.6.1, 4.7.6.2, 4.7.8)<br>• Impact on important habitat for marine fauna (Response to Submissions, First Public Review, as above and 4.8.1, 4.8.2, 4.8.3, 4.8.6.1, 4.8.6.2, 4.8.6.3)<br>• Alteration to natural drainage (Response to Submissions, First Public Review,, 4.7.6.2)<br>• Inadequate disposal of bitterns (Response to Submissions, First Public Review, 4.18.1, 4.18.2, 4.18.3, Response to EPA Comments issue 1)<br>• Impacts of pumping seawater (Response to Submissions, First Public Review, 4.8.5)<br>• Introduction of marine pests and spillages from bulk carriers (Response to Submissions, First Public Review, 4.8.4, 4.9.3, 4.9.5)<br>• Impacts of dredging (Response to Submissions, First Public Review, 4.8.6.1, 4.17.2.2)<br>• Impacts on fisheries industry (Response to Submissions, First Public Review, 4.7.2, 4.7.3, 4.7.3.1, 4.7.4, 4.7.6, 4.7.6.1, 4.7.6.2, 4.7.8, 4.8.5, 4.9.1, 4.9.2, 4.9.3, 4.9.5, 4.9.6, 4.9.7, 4.10.1)<br>• Exposure of Acid Sulphate Soils (Response to Submissions, First Public Review, 4.2.1, 4.2.1.1, 4.2.1.2, 4.7.3.2)<br>• Scale not acceptable (Response to Submissions, First Public Review, 3.1 Revised Key Project Characteristics |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 6 | Conservation Council | <u>New Issues Raised</u><br>• Possible future expansion of the proposal (Section 3.1.1)<br>• Impacts on surface hydrology: lack of redistribution of outwash flows around salt ponds (Section 3.4.1)<br>• Lack of understanding of stratigraphy of supratidal flat and fatal flaws in understanding hydrology (Section 3.2.3)<br>• Sea level rise of between 35 and140 cm this century will prevent redistribution of algal mats and mangroves (Section 3.12.3)<br>• Impacts related to salt flat conduits of brine to the ocean and to deeper karst aquifers (Section 3.3.1)<br>• Relative importance of terrigenous inputs for maintaining biological productivity (Section 3.7.5)<br>• Management plans provide no conceivable actions for protection of marine wildlife (Section 3.8.1)<br>• Lack of decommissioning plan and inability to remediate solar salt pond operation (Section 3.13.1)<br><u>Issues Already Addressed</u><br>• Environmental significance of eastern side of Exmouth Gulf (Response to Submissions, First Public Review, 4.11.1.2, 4.11.3 and Response to Submissions, Second Public Review, 3.11.1)<br>• Vacant ecosystem hypothesis (Response to Submissions, First Public Review, 4.7.9)<br>• Bitterns management (Response to Submissions, First Public Review, 4.18.1, 4.18.2, 4.18.3 and Response to EPASU issue 1)<br>• Geoheritage (Response to Submissions, First Public Review, 4.11.1.1)<br>• Use of Bruun Rule (Response to Submissions, First Public Review, 4.14.3.1)<br>• Potential changes to micro-climate and coastal subsidence (Response to Submissions, First Public Review, 4.14.8, 4.14.4)<br>• Hydrological connection between hinterland and coast (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 6 | Conservation Council | • Importance of terrigenous nutrient inputs (response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8)<br>• Changes to salinity regime (Response to Submissions, First Public Review, 4.6.5)<br>• Dredging impacts on marine fauna (Response to Submissions, First Public Review, 4.8.6.1)<br>• Dugong mortality (Response to Submissions, First Public Review, 4.8.6.2)<br>• Bitterns storage impacts on migratory shorebirds (response to Submissions, First Public Review, 4.5.4.1 see also Response to Submissions, Second Public Review, 3.15.9) |
| 7 | Pearl Producers Association | <u>Issues Already Addressed</u><br>• Introduction of marine pests (Response to Submissions, First Public Review, 4.8.4, 4.9.3, 4.9.5)<br>• Nutrient content in water – changes to nutrient flows (Response to Submissions, First Public Review, 4.3.7.1, 4.3.7.3, 4.3.8, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.3, 4.3.10.5)<br>• Management of bitterns. (Response to Submissions, First Public Review, 4.18.1, 4.18.2, 4.18.3 and Response to EPASU issue 1)<br>• General waste disposal (Response to Submissions, First Public Review, 4.17.1, 4.17.2, 4.17.2.1, 4.17.2.2) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 8 | MG Kailis | Issues Already Addressed<br>• Alteration of surface flows and loss of productivity (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8 and Response to Submissions, Second Public Review, 3.4.3)<br>• Impacts on groundwater and mangroves (Response to Submissions, First Public Review, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.3.6, 4.7.2)<br>• Bitterns management (Response to Submissions, First Public Review, 4.18.1, 4.18.2, 4.18.3, Response to EPASU Issue 1)<br>• Impacts from water pump intake (Response to Submissions, First Public Review, 4.8.5)<br>• Introduction of NIMS (Response to Submissions, First Public Review, 4.8.4, 4.9.3, 4.9.5)<br>• Sea level rise impacts on algal mats and mangroves (Response to Submissions, First Public Review, 4.11.2, 4.14.1, 4.14.1.1, 4.14.1.2, 4.14.3.2 and Response to Submissions, Second Public Review, 3.12.3)<br>• Dredging and ASS (Response to Submissions, First Public Review, 4.8.6.1, 4.2.1, 4.2.1.1, 4.2.1.2, 4.7.3.2)<br>• Inadequate fisheries assessment (Response to Submissions, First Public Review, 4.7.2, 4.7.3, 4.7.3.1, 4.7.4, 4.7.6, 4.7.6.1, 4.7.6.2, 4.7.8, 4.8.5, 4.9.1, 4.9.2, 4.9.3, 4.9.5, 4.9.6, 4.9.7, 4.10.1)<br>• Scale and timeframe (Response to Submissions, First Public Review, 3.1 Revised Key Project Characteristics) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 9 | Wildflower Society | <u>New Issues Raised</u><br>• Significance of area of impact from flood backwaters behind diversion dam (Section 3.5.1)<br>• Lack of sampling of summer and winter ephemeral species due to lack of rain and hence inadequate botanical research (Section 3.5.2)<br>• Lack of management of weed species (Section 3.5.3)<br><u>Issues Already Addressed</u><br>• Changes to surface hydrology (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8 and Response to Submissions, Second Public Review, 3.4.3)<br>• Importance of terrigenous inputs (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8)<br>• Clearing of algal mat (Response to Submissions, First Public Review, 4.7.6.1)<br>• Impacts on claypans (Response to Submissions, First Public Review, 4.2.3)<br>• Nationally significant wetland (Response to Submissions, Second Public Review, 3.11.1) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 10 | Wetlands Research Association | New Issues Raised<br>• Stratigraphy provided by additional drilling shows presence of preferred aquifer conduits to act as preferred seepage layers (Section 3.2.4)<br>• Evidence of limestones acting as a substantial porous and permeable aquifer (Section 3.2.5)<br>• Freshwater discharges into tidal flats (Section 3.4.2)<br>• Predominance of sandy, limestone and gravelly materials in surficial aquifer presented in bore logs need attention (Section 3.2.6)<br>• Details of the stratigraphic relationship of the salt flats to the mangrove is missing (Section 3.2.7)<br>• Inadequate assessment and understanding of relationship between 0.8m hydraulic head and seepage through sand and limestone aquifers (Section 3.2.8)<br>• Lack of identification of aquifers (Section 3.2.9) |
| 11 | BH1 | New Issues Raised<br>• Difficult to ascertain the intended figure for the volume of limestone to be extracted from the barge harbour (Section 3.2.10)<br>• Required quantities of limestone armour not evidently available from barge harbour/channel (Section 3.2.11) |
| 12 | BL1 | New Issues Raised<br>• Lack of baseline assessment of the ecosystem structure and functions of intertidal habitats within development area (Section 3.7.6) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 13 | BS1 | <u>New Issues Raised</u><br>• Changes to overland flow resulting in reduced deposition of sediment and associated decline in seagrass abundance (Section 3.7.7)<br>• Increased recreational use of eastern side of Gulf due to improved overland access (Section 3.10.1)<br><u>Issues Already Addressed</u><br>• Blocking of surface flows from hinterland (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8 and response to Submissions, Second Public Review, 3.4.3)<br>• Impact of development on benthic habitat and primary producers (Response to Submissions, First Public Review, 4.7.2, 4.7.3, 4.7.3.1, 4.7.4, 4.7.6, 4.7.6.1, 4.7.6.2, 4.7.8)<br>• Sea level rise (Response to Submissions, First Public Review, 4.11.2, 4.14.1, 4.14.1.1, 4.14.1.2, 4.14.3.2 and Response to Submissions, Second Public Review, 3.12.3)<br>• Potential impacts on dugongs (Response to Submissions, First Public Review, 4.8.1, 4.8.3, 4.8.6.1, 4.8.6.2) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 14 | BM1 | <u>New Issues Raised</u><br>• The reduced project will return only relatively small economic and social benefits (Section 3.14.1)<br>• Additional vegetation /flora information not comprehensive enough and little known vegetation types should be protected (Section 3.5.4)<br>• Vegetation quadrats not included in diversion dam impact area (Section 3.5.5)<br>• Lack of regional data set for terrestrial vegetation assessment should result in suspension of project until information available (Section 3.5.6)<br>• Pristine nature of the area and low incidence of invasive species should be considered as values (Section 3.11.2)<br>• Impacts to designated 'high reservation priority ecosystems' should be avoided (Section 3.11.3)<br>• Further detailed and comprehensive research and analysis should be conducted in relation to subterranean fauna (Section 3.6.2)<br><u>Issues Already Addressed</u><br>• Potential for impact on Ningaloo Reef (Response to Submissions, First PublicReview, 4.7.7)<br>• Possible future expansion (Response to Submissions, Second Public Review, 3.1.1)<br>• World Heritage (Response to Submissions, First Public Review, 4.11.1.1)<br>• Relevance to strategic government planning, policy and management (Response to Submissions, First Public Review, 4.7.2, 4.11.1.1, 4.11.1.2, 4.11.2, 4.11.4)<br>• Incompatibility with tourism focus on Ningaloo Marine Park (Response to Submissions, First Public Review, 4.7.7, 4.11.3, 4.11.5)<br>• Weed management (Response to Submissions, First Public Review, 4.4.2 and Response to Submissions, Second Public Review, 3.15.10)<br>• Ecological significance of Hope Point benthic habitat (Response to Submissions, First Public Review, 4.7.1.3) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| | | • Impacts on seagrass (Response to Submissions, First Public Review, 4.6.2, 4.7.1.3, 4.7.3.4, 4.7.6.1)<br>• Changes to dredge impacts due to changes to barge channel (Response to Submissions, First Public Review, 4.9.2) |
| 15 | Tourism WA | <u>New Issues Raised</u><br>• Economic and social benefits to Exmouth region relative to tourism (Section 3.10.2)<br><u>Issues Already Addressed</u><br>• Sustainability (Response to Submissions, First Public Review, 4.16.1.1)<br>• Incompatible with tourism focus on Ningaloo Marine Park (Response to Submissions, First Public Review, 4.7.7, 4.11.3, 4.11.5)<br>• World Heritage (Response to Submissions, First Public Review, 4.11.1.1)<br>• Impacts of boats on aquatic mammals with respect to research on Shark Bay dolphins (Response to Submissions, First Public Review, 4.8.6.3)<br>• Nutrient flows (Response to Submissions, First Public Review, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8)<br>• Impacts to conservation values (Response to Submissions, First Public Review, 4.11.1.2, 4.11.3 and Response to Submissions, Second Public Review, 3.11.1) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 16 | BW1 | <u>New Issues Raised</u><br>• Potential impacts on freshwater soak at Hope Point (section 3.4.3)<br><u>Issues Already Addressed</u><br>• Potential for impact on Ningaloo Reef (Response to Submissions Volume 1, 4.7.7)<br>• Bitterns management (Response to Submissions Volume 1, 4.18.1, 4.18.2, 4.18.3, Response to EPASU issue 1)<br>• Nutrient flows (Response to Submissions Volume 1, 4.3.7, 4.3.7.1, 4.3.7.2, 4.3.7.3, 4.3.7.4, 4.3.9, 4.3.10, 4.3.10.1, 4.3.10.2, 4.3.10.3, 4.3.10.5, 4.7.8) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 17 | Cape Conservation Group | Issues Already Addressed<br>• Possible future expansion of proposal (Response to Submissions, Second Public Review, 3.1.1)<br>• Impact on wilderness values (Response to Submissions, First Public Review, 4.10.5)<br>• Potential for impact on Ningaloo Reef (Response to Submissions, First Public Review, 4.7.7)<br>• World heritage (Response to Submissions, First Public Review, 4.11.1.1)<br>• Relevance to strategic government planning, policy and management (Response to Submissions, First Public Review, 4.7.2, 4.11.1.1, 4.11.1.2, 4.11.2, 4.11.4)<br>• Incompatibility with tourism focus on Ningaloo Marine Park (Response to Submissions, First Public Review, 4.7.7, 4.11.3, 4.11.5)<br>• Weed management (Response to Submissions, First Public Review, 4.4.2, Response to Submissions, Second Public Review, 3.15.10)<br>• Ecological significance of Hope Point benthic habitat (Response to Submissions, First Public Review, 4.7.1.3)<br>• Impacts on seagrass (Response to Submissions, First Public Review, 4.6.2, 4.7.1.3, 4.7.3.4, 4.7.6.1)<br>• Changes to dredge impacts (Response to Submissions, First Public Review, 4.9.2)<br>• Relatively small economic and social benefits (Response to Submissions, Second Public Review, 3.14.1)<br>• Additional vegetation survey not comprehensive enough (Response to Submissions, Second Public Review, 3.2.5)<br>• Vegetation quadrats from additional vegetation survey not included in diversion dam impact area (Response to Submissions, Second Public Review, 3.5.5)<br>• Lack of regional data set for terrestrial vegetation assessment should result in suspension of project until this information is available (Response to Submissions, Second Public Review, 3.5.6)<br>• |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| | | • Pristine nature of area and low incidence of invasive species should be considered as values (Response to Submissions, Second Public Review, 3.11.2)<br>• Impacts to designated 'high reservation priority ecosystems' should be avoided (Response to Submissions, Second Public Review, 3.11.3)<br>• Further detailed research should be conducted in relation to subterranean fauna (Response to Submissions, Second Public Review, 3.6.2) |

| Submission No. | Submitter | Issues Raised |
|---|---|---|
| 18 | Department of Fisheries (DoF) | <u>New Issues Raised</u><br>• Revised proposal does not give a sufficient level of comfort that there will not be impacts on nutrient cycling and productivity in the Gulf. (Section 3.7.8)<br>• Altered hydrological processes potentially causing impacts on productivity (Section 3.4.4, 3.7.3, 3.7.4, 3.7.5)<br>• Uncertainty over hydrological model and potential for long term subsurface discharge of highly saline groundwater (Section 3.3.2)<br><u>Issues Already Addressed</u><br>• Impact on prawn productivity from cyclonic events and changes to hydrology (Response to Submissions, First Public Review, 4.3.10.2)<br>• Bitterns disposal and management (Response to Submissions, First Public Review, 4.18.1, 4.18.2, 4.18.3 and Response to EPASU issue 1)<br>• Introduction of NIMS and diseases (Response to Submissions, First Public Review, 4.8.4)<br>• Entrainment of prawn larvae at pump station (Response to Submissions, First Public Review, 4.8.5)<br>• Impacts of pump station on nearshore salinity (Response to Submissions, First Public Review, 4.6.5)<br>• Dredging operations (Response to Submissions, First Public Review, 4.6.2, 4.17.2.2)<br>• Shipping movements and salt loading (Response to Submissions, First Public Review, 4.9.6, 4.10.6, 4.6.8.2)<br>• Interactions with other users (Response to Submissions, First Public Review, 4.9.6, 4.9.7, 4.10.1, 4.10.5, 4.10.6) |

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