

Please find attached a submission from the Department of Water (Pilbara Region) on the Yannarie ERMP.

Regards

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ATTENTION: DR SUE OSBORNE

**YANNARIE SOLAR SALT
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME (ERMP)
(ASSESSMENT 1521)**

The Environmental Review and Management Programme (ERMP) for the Straits Salt Pty Ltd, Yannarie Solar (Assessment No. 1521) was received by the Department of Water on the 5th December 2006. The Department of Water (Pilbara Region) has reviewed the document and provides the following comments.

In preparing these comments the Department of Water (Pilbara Region) has given consideration of the potential impacts of the project on water resources and groundwater dependant ecosystems, and whether these impacts could be managed through legislative mechanisms. In addition the Department has provided comment to the EPA on the robustness of the assessment methods and information used to determine environmental impacts from changes in hydrological cycles.

REVIEW OF ISSUES

The cumulative effects of project operations and the potential changes in the natural groundwater and surface hydrology are not sufficiently understood at this stage for the Department of Water to be certain that no significant environmental impacts will occur from the project. The information provided in the ERMP addressing groundwater and surface water issues is not satisfactorily supported. The proponent should conduct a number of additional studies, including groundwater investigations, document reviews and subsequent geotechnical investigations, so that changes to the hydrology can be quantified. Once this has been done, the EPA should seek specialist advice on possible impacts of the project and any predicted changes to the hydrology of the eastern side of Exmouth Gulf.

GROUNDWATER IMPACTS

The DoW Pilbara Region is concerned that the natural hydrological processes are not understood well enough to enable possible impacts of the project on natural groundwater flows to be assessed appropriately. The project will impose changes to the natural hydrological system and a number of issues will need to be considered to determine what these impacts will be. To gain a sufficient understanding of this the following should be addressed;

- The natural groundwater system may be influenced by the supra-tidal hydrology. The proponent's understanding that there are no natural vertical movements through the clay barrier layer (Fig 4-8) is not supported by the detailed geotechnical investigations done by Halpern-Glick in 1966, in which the complex structure of the limestone is discussed. This report was not available to Parsons Brinckerhoff in the 2005 interpretation. Work done on the similar geological units on the eastern side of Exmouth Gulf (for the Exmouth water supply) show that a karstic weathering surface extends beneath the water table, and is responsible for solution features and groundwater flows below sea level and beneath the alluvial material (Geological Survey Hydrogeology Report 1990/36). **It is recommended that further investigations on the relationship between the natural groundwater system and the supra-tidal hydrology are undertaken.**
- The proponent's assumption that the horizontal layering beneath the supratidal saltplains is uniformly flat-lying needs to be tested with confirmatory geophysics or geotechnical drilling to at least the depth at which natural capillarity or forced downward leakage can be expected. These depths can be assessed using the Halpern-Glick investigation data plus the hydraulic permeability measurements of Parsons Brinckerhoff 2005, but the uniformity of distribution needs to be mapped spatially by some geoscientific means. **It is recommended that geophysics or geotechnical drilling is undertaken to at least the depth at which natural capillarity or forced downward leakage can be expected.**
- The limestone outcrops and subcrops identified on the mainland remnants within the supratidal areas should be mapped and correlated, to allow a geomorphic history of the gulf and plains to be developed. Work on the western side of Exmouth Gulf has identified four limestone units, and some or all of these should exist in the Yannarie project area. These units have differing permeabilities and solution features. The limestone mapping must include spatial logging (including elevation AHD) of limestone outcrops. The limestone outcrop and subcrop areas provide potential pathways for the natural movement of water of various qualities and nutrient loads through the natural water cycle. Should salt operations commence, any karstic limestone pillars could provide vertical/horizontal conduits for hypersaline or contaminated water such as bitterns, into the natural system under the force of the weight of stored salt waters. **It is recommended that the limestone outcrops and subcrops in the supratidal flats are mapped and investigations undertaken to determine the risk of these limestone areas acting a potential brine pathways.**
- There is also potential for the occurrence of offshore springs (of uncertain water quality) due to the typical karstic nature of the underwater limestones - platforms of these limestones can be seen from the air. Offshore springs are known to support localised shallow marine communities worldwide, but the relationship of biological sub-communities to localised water quality differentials is not well understood in Western Australia. These offshore springs are found in Cockburn Sound and in the Shark Bay region of WA. Karst springs at sea level in Northern Australia are known to be critical to certain mangrove species. Karst springs above sea level can support specific vegetation communities on land, and can also drive small-scale fluvial environments. **It is recommended that investigations are undertaken to determine if offshore**

springs are present. If found to be present, further investigations should be made to ascertain the relationship of biological sub-communities to the springs and the impact of the project on the springs.

The EPASU has requested certain works be considered by Straits to provide sufficient information to address the above points. The first two tasks described below will address the Department of Waters' concerns raised above, the third will address concerns about potential changes to heavy metal accumulation that have been separately raised by the DEC Contaminated Sites Branch, and the fourth is already being actioned by Straits and is of one of the three supplementary reports to be provided by Straits (as identified in the Invitation page of the ERMP document). The italicised text below is the EPASU's request to Straits sent in Jan 2007, but still to be agreed between Straits, the EPASU and the various regulatory Branches of DEC and DoW.

The ERMP does not provide enough information to assess potential impacts on the environment that may occur if the construction of the proposed salt fields alters hydrogeological regimes. Of particular concern is the apparent level of uncertainty relating to the potential for toxic release of heavy metals that may have accumulated as a result of evaporative processes. To better understand the likely impacts associated with this issue, the EPASU requests that you undertake a more in depth analysis that will better describe the physical and chemical characteristics and processes of the groundwater, sediments and rocks associated with the saline flats and mainland outlier islands and that you better define the levels of risk associated with the likely impacts of salt field construction on these processes. To this end, while the responsibility for addressing these concerns remains with the proponent, the EPASU suggests the following approach:

1. *Characterisation of the saline flat geology and groundwater, in particular the depth and thickness of the clay layer, the presence of any karst features in the underlying limestone such as tidal springs, plus ground water regimes such as the identification of preferred flow paths between the sea and the saline flats or associated with ancient deltaic deposits. Geophysical methods such as shallow seismic may assist, but a series of targeted and logged boreholes will also need to be drilled. In addition, a thorough search for previous literature on the area needs to be undertaken and the characterisation should include the results of previous surveys such as the 1966 Exmouth Salt feasibility study which indicates that there is an underlying limestone layer.*
2. *Demonstrate that the clay material acts as an aquiclude which both prevents the downward migration of water from the surface layers to deeper aquifers and prevents any natural evaporation processes from the aquifers below the clays. This will require an analysis of the continuity of the layer below the proposed salt field as well as a demonstration of its physical characteristics.*
Such a demonstration might include laboratory analyses of clay samples from targeted locations at the development site and should cover the range of salinities proposed in the salt farm. Analyses might include:
 - *calculations of capillary heights at different thicknesses of clay;*
 - *measurements of downward infiltration rates as a result of vertical pressure from the 1m water height in the salt ponds.*
 - *chemical characterisation of paired groundwater samples taken from above and below the clay layer.*
3. *Characterisation of the chemical composition of sediments, in particular heavy metal concentrations to investigate the potential for toxic release*

both above and below the clay layer. This will include laboratory analyses of samples from the site of the proposed development.

- 4. Subterranean fauna. This issue has already been discussed and it is understood that a sampling regime is being drafted.*

The Department requests that the above works are conducted prior to making final comment on whether the project is acceptable in its current form.

As the project will not require significant volumes of groundwater to be abstracted, the main regulatory tool which the Department can use to manage environmental impacts from this project will be "Bed and Banks permits" issued under the *Rights in Water and Irrigation Act (1914)*. Permits will be required for the diversions of Rouse Creek and Yannarie River.

SURFACE WATER FLOW REGIME CHANGES

While modeling shows that no significant runoff occurs in either the Yannarie or Rouse systems from the annual and 2-year ARI rainfall events, it is the impact of larger 1 in 50 and 1 in 100 ARI events that must be considered. Evidence from satellite imagery taken after heavy rainfall, such as that associated with cyclonic events, shows that surface water flows carrying terrestrial sediment and nutrients floods into the marine environment along the entire coastline of the Exmouth Gulf Wetland.

The importance of these surface water flows in the supratidal flats and the intertidal mangrove zones has not been considered adequately by the ERMP. While surface water flows reaching the Gulf are intermittent, the role of surface water flow from these systems is poorly understood. The DoW has some capacity under s17 of the *Rights in Water and Irrigation Act 1914* (permit to obstruct or interfere with bed and banks) to manage the diversion of the Rouse Creek and Yannarie River systems. However, this capacity is limited and does not allow for effective management of the impact of water flow alteration and the potential impacts on the downstream ecology to the Exmouth Gulf. **Further investigation into the environmental requirements of surface water flow in the supratidal flats and intertidal mangrove zones is required to determine if the diversion of the Yannarie and Rouse River systems will have a significant impact on the integrity of these ecosystems.**

It is recognised in the ERMP that diversion or redirection of the Yannarie River Flow around the salt operations will alter local hydrology patterns and may cause changes to watercourse morphology. This will change the natural surface water interactions over the entire area of the diversions and floodouts. This area has not been identified as part of the project footprint. Any native vegetation impacted by changed flooding regimes should be assessed as being vegetation clearing due to mining operations. New floodout areas may possibly be established by the diversions, and these have potential to affect natural recharge mechanisms to the groundwater system inland of the project. The Department of Waters' Surface Water Assessment staff have assessed only the engineering factors and has not identified any serious design flaws in the project engineering. The Department's regional office has assessed the potential for the diversions to affect the natural environment.

EXMOUTH GULF EAST WETLAND

The 46,100 Ha footprint of proposed project overlaps a significant portion of the Exmouth Gulf East wetland. This coastal wetland is listed on the *Directory of Important Wetlands in Australia*. Conservation category wetlands are the highest priority wetlands and the objective is the preservation of wetland attributes and functions. In addition, the EPA states in *Environmental Offsets Preliminary Version 2 Position Statement No. 9* (EPA,

2004) that Conservation category wetlands are recognised as 'critical assets', which represent the most important environmental assets in the State that must be fully protected and conserved.

The Environmental Protection Authority has set some broad principles for the protection of wetlands (EPA, 2005). This includes the goal to *protect, sustain and, where possible, restore the biological diversity of wetland habitats in Western Australia and to protect the environmental quality of the wetland ecosystems of Western Australia through sound management in accordance with the concept of 'wise use', as described in the Ramsar Convention, and ecologically sustainable development principles, regardless of land use or activity* (EPA, 2005).

The large scale of the works proposed by Straits Salt will adversely effect the environmental function and value of Exmouth Gulf East Wetland. The value and the impact of the loss of this nationally important wetland was not discussed in the ERMP. The significance of the Wetland needs to be considered as a major asset that will be adversely impacted by the project.

FLOOD AND STORM SURGE

The Pilbara is the most prone area of Australia's coast to cyclonic activity. Overall it is estimated that a cyclone impact causing wind gusts in excess of 90 km/h in the vicinity of Exmouth occurs about once every two to three years on average (Bureau of Meteorology). Storm surge associated with cyclone activity has potential to inundate the project area. Flood and storm surge impacts can be modelled based on available surface and remotely-sensed information. This was reviewed by the Surface Water Assessment group, but the group did not assess the proponent's assertion that extreme events will result in identical impacts whether or not the project goes ahead. Shell, coral and animal remains found in the supratidal area could provide additional background on extreme climatic events. **The Department recommends that storm surge assessments should be undertaken by Department of Planning and Infrastructure.**

RECOMMENDATIONS

As the hydrology of the area is poorly understood, the Department of Water (Pilbara Region) recommends that further investigations are undertaken by the proponent to gain a better understanding of the surface water and groundwater hydrology and hydrogeology. These investigations should determine the significance of the hydrological systems to the functions of the Exmouth Gulf and the Exmouth Gulf East Wetland. The Department recommends that:

- Further investigations on the relationship between the natural groundwater system and the supra-tidal hydrology are undertaken,
- Geophysics or geotechnical drilling is undertaken to at least the depth at which natural capillarity or forced downward leakage can be expected,
- Limestone outcrops and subcrops identified within the supratidal areas should be mapped and correlated, to allow a geomorphic history of the gulf and plains to be developed,
- Investigations are undertaken to determine the risk of karstic areas acting as conduits for hypersaline or contaminated water from ponds into the ocean or groundwater,
- Investigations are undertaken to determine if offshore springs are present. If found to be present, further investigations should be made to ascertain the relationship of biological sub-communities to the springs and the impact of the project on the springs,
- The request by the EPASU to "*undertake a more in depth analysis that will better describe the physical and chemical characteristics and processes of the groundwater,*

sediments and rocks associated with the saline flats and mainland outlier islands" is conducted prior to the final assessment of the ERMP,

- Further investigation into the environmental requirements of surface water flow in the supratidal flats and intertidal mangrove zones is required to determine if the diversion of the Yannarie and Rouse river systems will have a significant impact on the integrity of these ecosystems,
- The significance of the Exmouth East Wetland needs to be considered as a major environmental asset that will be adversely impacted by the project, and
- Storm surge assessments should be undertaken by the Department of Planning and Infrastructure.

Should you require clarification of any of these points please contact the Karratha office of the Department of Water on (08) 9144 2000.

Yours sincerely

Steve Bellussi
A/ Regional Manager – Pilbara Region
12 March 2007



Memorandum

TO: Dr Sue Osborne, Mining and Industrial Assessments
FROM: Manager, Surface Water Assessment
CC:
DATE: 3 January 2007
RE: Yannarie Solar ERMP - Hydrologic Review
FILE NO: 18763

The Surface Water Assessment Section has completed its review of *Yannarie Solar: Environmental Review and Management Programme – Volume 1 Environmental Review* (November 2006).

In particular, the review has focussed on the hydrologic and hydraulic impacts associated with the diversion of surface water systems. Generally, the surface water hydrology of the area is poorly understood and the report has provided a satisfactory summary of runoff generation and flood flows in the area.

Based on information provided in the documentation, the Surface Water Assessment Section does not have any concerns with the proposed surface water monitoring program or proponent commitment to prepare a surface water management plan addressing key issues.

Regards
Mark Pearcey

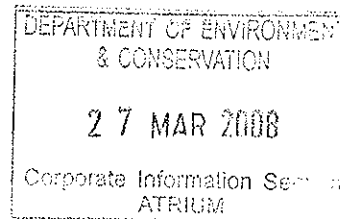


SCANNED

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ATTENTION: DR SUE OSBORNE



**YANNARIE SOLAR SALT
SUPPLEMENTARY INFORMATION
ASSESSMENT 1521**

Thank you for your letter dated 22 February 2008 requesting comment on the supplementary information relating to the proposed Yannarie Solar Salt Farm on the East Coast of the Exmouth Gulf. The Department of Water (DoW) Pilbara Region has reviewed the information and offers the following advice.

Groundwater Impacts

The DoW previously raised concerns that natural hydrological processes were not sufficiently understood to allow appropriate assessment on the potential impacts of the project on natural groundwater flows. Following discussions with the DoW, the proponent has undertaken a hydrogeological investigation drilling program. The DoW has made the following assessment of the drilling results provided in the technical report:

- 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.
- No fresh or brackish aquifers were identified in drilling, so there is no freshwater resource to protect for the environment or other users.
- No offshore springs have been located in investigations to date, but these may occur, and may contribute to the specific habitat of the Gulf. There is no evidence either way for project impacts on such springs to be assessed, and the amount of work needed would be very expensive and costly for incomplete information. A desktop risk-assessed judgment of possible impacts could be made, but would be based on little observation, and the DoW sees such an approach as being of limited practical value.

Surface Water Flow Impacts

- 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 the ponds.

- Surface water hydrology around the containment bunds will need active management throughout the life of the project, given cyclonic frequency and predicted climate changes.

Subterranean Fauna

- The DoW is satisfied that there is a low impact level in regards to any subterranean ecosystems present. Given the observed highly-saline samples collected during drilling, any likely stygofauna habitat would be below the depth of influence of the changed hydrology.

Exmouth Gulf East Wetland

- The proponent has not discussed the value and the impact of the loss of this Nationally Important Wetland. It should be considered as a major asset that will be adversely impacted by the project. The DoW requests that the EPA considers whether the changes to this wetland as a result of the project are consistent with the EPA's principles.

The Department of Water, Pilbara Region has considered the supplementary information and considers the water issues to be manageable. The Department would provide technical advice to the DEC regarding the management of other environmental impacts as requested.

Yours sincerely,



Darryl Abbott
A/Regional Manager
Pilbara Region

26 March 2008