

CENTREX METALS LTD

Port Spencer Stage 1 Executive Summary and Public Environmental Report

Volume 1 of 5



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Executive Summary and Public Environmental Report

EXECUTIVE SUMMARY

This Executive Summary was prepared to accompany the Port Spencer Stage 1 Public Environmental Report (PER). It provides an overview of the Project, a summary of the technical studies completed and the management measures proposed by Centrex Metals Ltd (Centrex) to minimise potential negative impacts arising from Port Spencer's development. The PER was prepared by Golder Associates Pty Ltd on behalf of Centrex.

Introduction

Centrex is proposing to develop Stage 1 of the private multi-user Port Spencer (the 'Project' or the 'Port') located on the east coast of Eyre Peninsula, South Australia, approximately 21 km north-east of Tumby Bay and 20 km south-west of Port Neill. This PER is submitted pursuant to the provisions of section 46 ('Major Development') of the *Development Act 1993* and the requirements of the project specific 2011 *Guidelines for the Preparation of a Public Environmental Report, Sheep Hill Deep Water Port Facility (Stage 1) on Eyre Peninsula* (the 'Guidelines') prepared by the South Australian Development Assessment Commission (DAC). The Project, formerly referred to as Sheep Hill Port, was renamed Port Spencer in late 2011.

Incorporated in 2001, Centrex is a publicly listed South Australian iron ore exploration and mining company. Centrex has extensive tenement holdings over iron ore resources and exploration targets on Eyre Peninsula in the southern Gawler Craton. They cover an area of 2,000 km² of iron ore deposits and prospects, including hematite and magnetite sources. Large iron ore reserves and other valuable minerals are yet to be recovered on Eyre Peninsula and across South Australia more generally. Recently Centrex obtained approval to undertake mining at the Wilgerup hematite deposit, which will be one of a number of Centrex's iron ore projects to be developed on the Eyre Peninsula in coming years. Other companies with mineral tenements and projects within the region include Eyre Iron Pty Ltd, IronClad Mining Ltd, Iron Road Ltd, Lincoln Minerals Ltd, Lymex Ltd, Minotaur Exploration Ltd, OneSteel Ltd, Samphire Ltd and Terramin Australia Ltd.

While resource demands continue to grow, particularly from China, there is increasing pressure for industry to plan for efficient transportation options, both from a carbon and energy efficiency perspective as well as reducing impacts from other transport options. Central to this is the development of suitable infrastructure to facilitate cost-effective and environmentally responsible transportation options for industry. The Project offers a significant regional opportunity to develop an alternative port and shipping option to Port Lincoln, create a localised option for the southern and mid-regions of Eyre Peninsula, reduce transport distances and improve the time taken to move product to market. In addition it offers the potential for a port capable of receiving Cape class vessels, not currently available on Eyre Peninsula, and a viable export option for mineral and agricultural businesses.

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Centrex proposes to construct a deep water marine port in Spencer Gulf, with a view to exporting Centrex's iron ore from Eyre Peninsula and providing the mining industry with effective access to international markets. The Project would be developed as a multi-user bulk commodity export facility capable of accommodating Panamax (65,000 to 90,000 tonne capacity) and Cape class (165,000 to 200,000 tonne capacity) vessels suitable for export of up to 20 million tonnes of ore per annum (mtpa) from a single berth configuration and single ship loader. The proposal also includes a road transport and infrastructure access corridor that would generally follow the alignment of the existing ungazetted Swaffers Road from Lincoln Highway. The Project may also serve as a multi-use export gate for grain and other mining companies in the Eyre Peninsula region.

The Project is proposed to be developed in four stages with Stage 1 being the subject of this PER. Stage 1 would be constructed to allow the export of hematite and grain. Stages 2 - 4 would allow for export of magnetite and be subject to further development approvals. Stage 2 would include development of a desalination plant for mine operation and Port use, and magnetite storage and processing infrastructure. Stages 3 and 4 of Port expansion (post-2014) would include expansion of magnetite storage and addition of extra hematite and grain storage facilities.

Investment in the Project is estimated to total approximately \$AUD250 million, (within a possible provisional estimate of 30% over or under spend), including detailed design and construction of the jetty, outloading materials handling system and ship loader, site access, establishment of onsite services and site preparation for fully enclosed receival and storage facilities. The capital and operating cost of receival and storage facilities would be the responsibility of each intended end user.

The location of the Project was selected on the basis of sea water depth to accommodate Cape class vessels without dredging, within a reasonable distance of the shore, as well as its close proximity to Centrex's mineral reserves on the Eyre Peninsula. The current marine shipping facility at Port Lincoln poses challenges and limitations for Centrex on a number of aspects, including local development opposition and sensitive port use by Port Lincoln fisheries. Marine shipping facilities outside of the Eyre Peninsula, such as Port Adelaide or Darwin, are high cost transport options which would result in larger economic impacts and carbon footprints. It is anticipated that use of the Port would reduce transportation costs and time, as well as the carbon footprint, of transporting minerals elsewhere for export.

Planning and Policy

This PER has considered relevant strategic and statutory planning context relevant to Port Spencer development. As a declared 'Major Development' this Project requires development approval by the Governor under section 48 of the *Development Act 1993* and will be assessed by the Minister for Planning (coordinated by DPTI). The assessment will take into consideration government agency and public comment on the PER, and will require Centrex to formally respond to these comments as part of the process. The final decision on approval will take into consideration the PER, Response Document to government and public comments, and the government's Assessment Report. The Project was not referred to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* as it is considered the Port does not have potential to negatively impact matters of National Environmental Significance.

Key strategic planning policy documents include the South Australia Strategic Plan 2011, the Strategic Infrastructure Plan for SA 2004/5 – 2014/15 and Regional Plan of the Eyre Peninsula. Port Spencer's development would support and contribute to a number of Strategic Plan targets including *Growing Prosperity* related to mineral production and exploration and increasing export values. Under the Strategic Infrastructure Plan for SA the Project would contribute to development of efficient, affordable and safe transport systems within South Australia that contribute toward increasing the value of South Australia's export income and increased investment in strategic areas of infrastructure (such as ports). These strategic plans also recognise the potential for improved port facilities on the Eyre Peninsula, which this Project would directly facilitate and export and port development related objectives.

The Project site is located within the jurisdiction of the Tumby Bay District Council Development Plan (consolidated 13 January 2011) and Land Not Within a Council Area (Coastal Waters) Development Plan (consolidated 31 March 2011).

Project Need, Benefit and Alternatives

The Project's viability directly relates to the feasibility of Centrex's magnetite mines on the Eyre Peninsula, and would only commence construction upon receipt of development approval from the government for both Stages 1 and 2, and determination of the viability of developing a magnetite mine. Centrex's current proposed program is for Port Stage 1 construction to start in Q3 2012, with operations commencing in Q4 2014.

Existing ports and alternative routes to market were considered as part of the early planning and feasibility studies for this Project. Seven alternative ports were considered including Port Lincoln, Whyalla and the proposed Port Bonython. Existing ports were not considered suitable to meet Centrex's mining and shipping needs, due to a number of reasons including proximity to iron ore deposits, ability to receive Cape class vessels, potential environmental impacts, economic costs, terminus congestion and likely community support.

Without the Project, Centrex and developers of other mineral deposits may face increased transport and economic costs and limited transport export options that could negatively impact the viability of mine development. Centrex has secured land at the Port and is well advanced in discussions with utility providers, other potential Port users and local government. The development of the Port as a multi-user facility offers potential commercial opportunities to other businesses on the Eyre Peninsula including agricultural and mineral sections.

The site was selected based on a range of considerations including access to deep water close to shore, potential environmental and social sensitivity, proximity to potential mineral resources, availability of land, and economic viability. Point Gibbon was also considered, however the Port Spencer site was considered to be a better option in all of the considerations listed previously.

The Project is proposed to be undertaken in Stages to reflect expected Centrex mining export requirements over time. This staged approach allows a more balanced investment with regard to capital expenditure and would facilitate Port development in the shorter rather than long term. Rather than waiting for all mine projects to develop at the same time, the Port can be developed to meet Wilgerup and other party needs. Port design provides for flexibility by considering potential future transport and other facility expansion options. In addition the Port's development would facilitate a number of benefits at local, regional and State level including environmental, economic and social aspects.

Stage 1 Infrastructure

Port Spencer Stage 1 development would provide for hematite ore and grain export capacity. Approximately 48 ha of land would be required for Stage 1 development and the total site footprint is 140 ha. Although the site layout was designed to provide flexibility for a potential rail corridor Centrex does not require rail for mine development in the short or long term. The site has considered rail in layout design in line with good engineering practice and providing flexible infrastructure options for possible future users. Stage 1 site infrastructure includes the following:

- Hematite storage shed, with a storage capacity of up to 240,000 t and an in-loading shed, site office, site warehouse for equipment storage.
- A number of grain storage options are being considered at this time and will be finalised during detailed design phase:
 - Grain storage shed, with a storage capacity of approximately 60,000 t, or
 - Three 20,000 t grain storage silos with a maximum height of 30 m, or
 - One bunker style grain storage area with a capacity of approximately 60,000 t.
- Grain in-loading shed, site office and warehouse for equipment storage.
- Site administration/office building, suitable for occupation by 20-30 personnel and associated amenities.
- Enclosed conveyor galleries for proposed ore and grain in-loading and out-loading conveyor.
- Sampling station and enclosure for automatic sampling of iron ore and grain for quality assurance.
- A truck weighbridge station, located at the haul road entrance point on Swaffers Road at the northern side of the site.
- Electrical switch room; approximate dimensions 12 m long x 5 m wide x 4 m high.
- 68,000 L heavy fuel oil storage tank and 10,000 L bulk diesel fuel tank.
- The jetty would extend from the shoreline into the marine environment 515 m to a lowest astronomical tide water depth of approximately 20 m. Dredging is not required as part of Project operational activities due to location of the jetty within deep water.
- Industrial ship loader located on the berth stand suitable for loading ore and grain material into Cape class and Panamax sized vessels with an approximate loading capacity of 5,000 ton per hour (t/h) for iron ore and 1,400 t/h for grain.
- Haul road transport and infrastructure access corridor, which is 5 km in length from the Lincoln Highway and generally follows the alignment of the un gazetted Swaffers Road.
- Light vehicle access is proposed from Lipson Cove Road to the south of the site.
- Fire service tanks and pump systems.
- Car parking, and
- Stormwater drains and detention basin.

Consultation

A major part of the Project has been the stakeholder consultation undertaken from initial concept through to development application and PER production. Centrex has met with local residents, landowners, local authorities and government regulators to discuss the Project, and listen to potential concerns. These discussions have influenced the proposed design and management of the Project. Since 2008 Centrex has published a series of newsletters to inform stakeholders regarding the Project and its progression. In 2011 Centrex undertook three major community consultation events in Tumby Bay, Port Neill and later in Port Lincoln, to which members of the public and local authorities were invited. In August 2011 as follow up to these consultations and to ensure transparency Centrex published a public Stakeholder Response Report. This report provided up to date information on the queries raised by stakeholders, and informed all stakeholders on the matters raised.

As part of the PER review process, Centrex provided draft copies of the PER and this Executive Summary to the government in December 2011.

Qualitative Risk Assessment

A qualitative environmental and social risk assessment was undertaken to consider potential Project impacts before and after proposed mitigation and management measures. Risk rankings considered the likelihood or frequency of the incident/impact occurring in the context of this development and consequence of an impact occurring. Risk categorisation included 4 possible rankings of low, moderate, high or extreme.

The findings of the risk assessment identified the residual risk for import or export of marine pests from the Port as the only high risk. This is a potential impact and risk that would be expected with any commercial port facility accepting foreign vessels for export or import activity. This residual risk is considered to be As Low As Reasonably Practicable (ALARP) and can be effectively managed with appropriate management and monitoring measures implemented at the site. The appointed port operator would be required to develop suitable environmental management and incident response plans for all onshore and marine impact scenarios and comply with all environmental monitoring requirements, including of marine pests. The potential risks associated with development of Port Spencer are considered to be commensurate with such activities and the site offers an overall low risk environmental and social impact option for such a facility. This site does not pose expected medium or long term negative impacts to terrestrial or marine flora or fauna species of regulatory listed conservation significance.

Existing Environment and Impact Assessment

Land use

Port Spencer is located on undulating land, with the shore line located on the eastern boundary of the site. Historically, the majority of the Port site was used for agricultural activities and is currently free of built development. The eastern coastal allotments of the site have not previously been used for any agricultural activities. Excluding the coastal boundary of the site, the Port is located within freehold land that is covered by two Tumby Bay District Council development planning zones; coastal and general farming zones. The adjoining properties and surrounding environment are predominantly large agricultural allotments for crop and livestock activities.

Climate

The climatic conditions at Port Spencer are characterised by hot, dry summers and cool moist winters, typical to those of a temperate zone. The Project area receives approximately 385 mm of rain per annum, the majority of which falls during the winter months. The wind direction varies throughout the year; during spring and summer the winds are predominantly from south-east and during autumn and winter predominantly north-west through to west.

CSIRO climate change risk scenarios predict the southern parts of South Australia are likely to become warmer and annual rainfall will decline. Sea levels are predicted to rise and ocean waves are predicted to change, resulting in increased risk of coastal inundation during severe storm events, coastal erosion and seabed disturbance. Due to Port Spencer's proximity to the coast, climate change impacts have been considered during the development and design of the Project. The jetty design has included potential sea level rise scenarios.

Port Spencer potential greenhouse gas (GHG) emissions were estimated including transport of ore and grain. GHG emissions during Stage 1 construction phase are estimated to be 33.5 kt CO_{2-e}. GHG emissions during the operational phase were considered in terms of electricity, fuel usage (associated with plant and equipment) and transport of ore and grain. Operational emission estimates vary depending on the transport option being considered. Providing an Eyre Peninsula based port to accommodate Cape class vessels, where extensive overland transport is not required, has the potential to reduce GHG emissions generated by existing transport options by between 40% and 90% for ore, and up to 50% for grain. Port Spencer offers a significant opportunity to reduce the GHG intensity of export transport from the Eyre Peninsula.

Geology and Soils

Port Spencer is located in the Kalinjala Shear Zone, which is a large-scale crustal structure on the Eyre Peninsula that separates the Donington Suite granites of the Project area from the Hutchison Group of metasedimentary schist, quartzite, dolomite marble and banded iron formations to the west. Soil profiles within the Project area consist of sodosols and tenosols and existing soil mapping indicates there is an extremely low probability of acid sulfate soil presence in the Project area.

A potential existing contaminant assessment indicated chemical concentrations in the soils were generally below the adopted guidelines for the protection of human health and ecological receptors, as well as the waste fill disposal limits. Chemical concentrations were below National *Environmental Protection (Assessment of Site Contamination) Measure 1999* for commercial/industrial land use, which is the measure consistent with the future use of the site.

During construction phase vegetation would be removed exposing soil to potential erosive processes from wind and water. During operations, potential impacts to soil include erosion of exposed natural surfaces from wind, rain or site stormwater and creation of dust through exposed soils. There is also potential for soil contamination as a result of chemical and fuel handling and storage onsite, material spillages and wastewater treatment.

Surface Water

There are no watercourses that traverse the Project site. The existing Port Spencer catchment drains to Rogers Beach which abuts the north of the Project boundary. Based on field inspections the overall catchment shows little erosion in areas exhibiting signs of overland and concentrated runoff. The region is characterised by predominantly winter rainfall.

The location of Port infrastructure has the potential to alter surface water flows to existing receiving environments and increase the volume and speed of water runoff due to the hard surfaces associated with Port infrastructure. Increased sediment loads in surface water may also result from increased erosion from exposed natural surfaces and build up of sediment in stormwater management channels. Potential contamination of surface water may result from activities such as refuelling of plant, spills or leaks from bulk storage of fuel or hazardous substances. Surface water and stormwater design was undertaken to reflect the principles of Water Sensitive Urban Design Principles, recognising water as a valuable resource and applying both precautionary and site specific solutions to water demand and resource management. Stage 1 Project design includes stormwater controls, such as drainage channels, and a detention basin sized to contain a 100 year storm event to prevent discharge of stormwater to the marine environment. Design has redressed the capture and reuse of stormwater from built infrastructure and site surface run-off.

Groundwater

The uppermost groundwater aquifer at the site is just above the mean sea level at < 3 m Australian Height Datum (AHD) in either fractured rocks or loose and unstratified sediments. Regionally groundwater flow direction is towards the coast. It is estimated groundwater flow direction at the Project moves towards the coastline and ocean to the east, Rogers Beach to the north and to the west-north-west of the site.

Groundwater quality at the Project area is typical of coastal groundwater discharge areas (i.e., brackish to saline). Groundwater samples taken as part of baseline studies recorded metal exceedances in unpredictable patterns. Given the current land use and lack of potential contaminants, the most likely explanation for metal exceedances is that metals occur naturally and are the product of groundwater-metamorphic rock interactions. Groundwater would not be used as part of Project activities. It is unlikely that groundwater would be directly impacted by the Project.

Air

The existing air quality in the vicinity of the Port is relatively pollutant free and is typical of a rural environment. The main sensitive receptors within close proximity to the Port (i.e. within 5 km) are considered to be rural residences. There are five sensitive receptors for air quality impact purposes within close proximity to the Port, that is, 400 m to 2 km.

Air modelling of the expected operation infrastructure and materials was undertaken for potential PM₁₀ and PM_{2.5} concentrations. Modelling outcomes indicated the Port would comply with the air assessment criteria at all sensitive receptors. The Project is not expected to negatively impact air quality.

Noise

No significant, permanent man-made noise sources are located at or near the Port. The Port is located in a rural, coastal environment with four sensitive receptors for noise impacts within close proximity. Noise limits and criteria for the Port are based on the *Environmental Protection (Noise) Policy 2007* noise levels consistent with the existing land use.

Noise modelling for Port activities, including vessels at berth, and associated transport corridor along Swaffers Road indicate that noise criteria would not be exceeded at sensitive receptors. For road transport activities along Swaffers Road, the noise criteria for night-time exposure are exceeded at one of the sensitive receptors. It is considered this can be managed with appropriate mitigation.

Traffic

Port Spencer can be accessed via Swaffers Road and Lipson Cove Road, both of which connect to the Lincoln Highway. Swaffers Road is located to the north and north-west of the Project site and would be the main heavy vehicle and infrastructure corridor for the Port. It is currently an unsealed no through road that terminates at private property near the coast. Lipson Cove Road is also a no through road located along the southern boundary of the site that terminates at the Lipson Cove camping ground. Lipson Cove Road would provide light vehicle access.

Potential impacts associated with heavy vehicle movements associated with the Port include increased pressure on the Lincoln Highway and Swaffers Road junction, light vehicles increasing pressure on the Lincoln Highway and Lipson Cove Road junctions, and potential noise impacts. Both roads would be sealed as part of any Project related development. The additional vehicle movements were assessed through actual road survey and predicted transport volumes. Based on the traffic assessment undertaken for this Project road safety upgrades are not required, however a number of turning and other road improvements to improve road safety would be considered should the Project be approved. Further discussion would be undertaken with the Department of Planning, Transport and Infrastructure through the detailed design phase to reach agreement on the scope of potential improvements, particularly as it relates to providing acceleration lanes for heavy vehicles on Lincoln Highway.

Terrestrial Ecology

The Port is situated within the Eyre Hills (EYB-3) subregion of the Eyre Yorke Block Bioregion. The Eyre Yorke Block Bioregion has been severely impacted due to vegetation clearance for agriculture and pastoral land use. The majority of the surrounding area is historically agricultural land with remnant vegetation largely restricted to a narrow strip along the coastal cliffs or within roadside reserves. The surrounding environment is similar to that of the Project area in so much as remnant native vegetation is concentrated along the coastal cliffs. Three distinct plant associations are present at the Port including degraded Low Shrubland along the coastal strip, highly degraded Tall Open Shrubland and fallow paddock characterised by weed and colonising species. The Tall Open Shrubland associated with Rogers Beach would be protected by a development exclusion zone.

A total of 19 introduced species, representing 33% of all species identified, were recorded within the Project area. No weeds of national significance were identified at the Port or along Swaffers Road. Three declared plant species (as per the South Australian *Natural Resources Management Act 2004*) were identified at the Port and along Swaffers Road. The presence of weeds and other invasive species is further indication the native vegetation associations are much degraded.

A spring field survey of the Project area identified 43 fauna species, which comprised 26 bird, 7 reptile, 1 frog, 6 mammal and 3 butterfly species. No flora or fauna species identified were listed under either the *National Parks and Wildlife Act 1972* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Eight introduced species were identified during the survey. The Project area does not contain habitat that is critical or limiting (as per the EPBC Act) for any listed fauna species.

Some native vegetation clearing would be required for Stage 1 development, which requires an approximate total area of 48 hectares. The area of expected native vegetation clearance for the Port site and Swaffers Road corridor is estimated at 15.66 hectares. Vegetation clearance is not expected to be a major impact for the Project. While the Low Open Shrubland along the coastal strip is degraded it remains of regional importance. Project onshore infrastructure is sited to minimise the requirement for clearing in this vegetation area. Only the jetty and related infrastructure would be required to cross this coastal vegetation, which is estimated to be an area of approximately 0.77 ha.

An offset is required for the approved removal of native vegetation and this offset is known as a significant environmental benefit (SEB), as defined by the *Native Vegetation Act 1991* (NV Act). Under the NV Act, terrestrial and marine native vegetation should be considered for SEB. Based on the total area and condition of terrestrial and marine flora (seagrasses) proposed to be cleared or impacted by Project activities. A total SEB of 21.02 ha was estimated to offset both terrestrial native vegetation (15.66 ha) clearance and the proposed impact upon marine seagrass beds (5.36 ha) in Port's vicinity. Proposed revegetation and rehabilitation along the south-east aspect of the site would significantly enhance the biodiversity value of the site including the coastal Low Open Shrubland. It is estimated that an area of 25.73 ha would be revegetated or enhanced through rehabilitation activities. This would result in a possible overall SEB credit of 4.71 ha.

Lipson Island

Lipson Island is located in the Lipson Island Conservation Park, located 1.5 km south from the proposed jetty. It is a low-lying island with extensive areas of bare rock and some sandy areas. It is recognised as a significant bird rookery and roost for a number of species listed under the NPW Act and EPBC Act.

Based on desktop review and field survey undertaken for this PER, Lipson Island is a nesting site for the little penguin (*Eudyptula minor*) and other burrow-nesting seabirds (a listed marine species under the EPBC Act). Other breeding colonies on Lipson Island include the black-faced cormorant (*Phalacrocorax fuscescens*), silver gull (*Larus novaehollandiae*) and crested tern (*Sterna bergii*), which are listed as marine species under the EPBC Act. The rock pigeon (*Columba livia*) and the common starling (*Sturnus vulgaris*) were the only introduced species of fauna recorded on Lipson Island. No significant flora is present on the island. No introduced or conservation listed marine flora or fauna species were found in the intertidal survey.

Given the distance of the Port to Lipson Island, existing oceanographic processes and the results of air, noise and hydrodynamic modelling potential negative impacts arising from the Project are not expected.

Marine Ecology

The following summary relates to the marine environment in and around the actual Project jetty site. Intertidal communities in the vicinity of the Port include small rocky headlands, which lie between intertidal sandy beaches to the north and south. Species recorded during marine field surveys are considered to be typical of species found on South Australian intertidal rocky shores. The intertidal sandy beaches in the vicinity of the Port are interspersed with outcrops of granite, basalt and other boulders. No significant intertidal shellfish beds, marine mammal haul out sites or seabird habitats were noted on the sandy beaches.

Subtidal communities include rocky reefs, seagrass and sandy substrate habitats. The composition of species in the shallow, rocky reef zone at the Port is typical of that described for temperate Australian subtidal reefs. The seagrass meadows present are considered to be typical of assemblages found in shallow, moderately-exposed locations across much of South Australia. Benthic macro-infauna of the seagrass habitat was dominated by the presence of crustaceans followed by annelids and to a lesser extent, molluscs. Benthic macro-infauna of the sandy mid benthic sites was dominated by annelids.

There were no endangered or threatened species under the NPW Act or EPBC Acts recorded during marine surveys. A male/female pair of crested threefin (*Trinorfolkia clarkei*) was recorded in rocky reef areas. Crested threefin are not a listed species. They are endemic to South Australia and in those areas they inhabit are recognised as common.

The Asian mussel (*Musculista senhousia*), an invasive marine species in Australia was found in the seagrass habitat in the vicinity of the Port. Although the Asian mussel is found elsewhere in South Australia, the recording of Asian mussels in the vicinity of the Port is an extension of the species' known distribution.

The key potential impacts to marine flora and fauna associated with Port development and operation are expected to relate to jetty shading of the sea floor and potential pest or invasive species from visiting shipping vessels. Shading by the jetty may result in the loss of species which are dependent on high levels of light in the area of the jetty. This impact is expected to be limited to a small area of direct influence and would not damage any areas or species of listed conservation significance. Significant environmental benefits (SEB), as defined by the *Native Vegetation Act 1991*, were estimated for potential construction and operation impacts to seagrass communities. An area of 0.52 ha is estimated to be impacted by the Project and a conservative SEB estimate of 5.36 ha was calculated for potential offset. Marine vegetation loss was considered as part of terrestrial native flora revegetation and rehabilitation offset planning.

The increase in density or introduction of pest/invasive species may potentially occur as a result of organisms being released as part of a ballast water discharge or as hull biofouling being translocated with shipping traffic. Australian rules for ballast water management would form part of overall Port management.

Shipping and Spills

The number of vessels expected at the jetty during early Project stages would be approximately 12 Cape class or 27 Panamax vessels per year for ore and 8 Panamax vessels for grain (i.e. a vessel every 18 days). 2 million tonnes of hematite and 0.5 million tonnes of grain would be exported.

The seawater depth at the jetty is approximately 8 m at the coast and drops to 20 m approximately 500 m off-shore and then continues to slowly increase in depth to 27 m. There is no current recommended shipping lane for vessels from the Project at this time, however a suitable path exists to the main shipping lane currently used by Cape class size vessels to access Onesteel Whyalla operations. Port related navigation aids and emergency response plans would be reviewed and established prior to operations.

Anchor dragging risks were investigated and anchor dragging is not expected to occur given the prevailing mild wind and wave conditions. In rough conditions, with wind speed exceeding 40 knots or current speed exceeding 3 knots, ships would be moved from the berth and anchored offshore. Vessels would be anchored approximately 4 km offshore in a minimum of 24 m depth of water for rough conditions and if waiting for berth access. A hydrographic study of the seabed would be undertaken prior to operations to ensure suitable obstruction free shipping lane and determine seabed bottom suitability for Cape class vessel anchors.

The majority of major oil spills in Australia have been associated with grounding as a result of high seas, poor weather conditions or uncharted reefs, and also associated with berthing incidents at wharves. The Project would not undertake hydrocarbon loading or unloading at the jetty or during shipping movement within Spencer Gulf. Offshore anchoring during rough weather is proposed 4 km offshore in deep water and the deep water Spencer Gulf shipping lane would not pose reef or grounding risks during Spencer Gulf transport. The Project poses a low risk of oil or chemical spill in the vicinity of the Port or Spencer Gulf.

Coastal Processes

Port Spencer is located within the Spencer Gulf, which is a relatively shallow embayment with an average depth of approximately 20m. The seafloor in the gulf is generally smooth with the predominant seafloor substrates characteristic of cool-water, high salinity carbonate sedimentation. Tidal variation in the Spencer Gulf is generally in the order of 2 m, but can be almost 0 m during neap (dodge) tides when virtually all tidal movements cease for a period of approximately 24 hours at 14 day intervals. Gulf waters become highly saline during summer owing to considerable evaporation. Salinity also varies across the gulf, increasing from west to east. The ambient average monthly water temperatures range from 10°C to 12.5°C in winter to 24°C to 28°C in summer.

Marine wind and wave surveys were undertaken at the Port site during winter, autumn and spring months. Overall the maximum current speeds measured at Port Spencer were between 0.34 metres per second (m/s) and 0.69 m/s, with larger current speeds observed at the top of the water column. Mean current speeds were 0.14 m/s at the top of the water column and 0.10 m/s and 0.09 m/s for the middle and bottom of the water column, respectively.

Wave energy in the Spencer Gulf ranges from moderate at the mouth of the gulf to very low in the upper regions. Wave heights were typically less than 1.0 m, but waves of up to 1.8 m have been recorded in the gulf. The Port location is largely protected from the strong swells; however, some swell waves do penetrate through the islands and headlands at the entrance to the gulf, with a medium swell height of 0.1 m. The largest waves occurring at the Port are generated by winds from the south-east, with the largest wave height calculated at 3.6 m (from a six year dataset).

Marine sediment movement is due to a combination of waves, tidal currents and wave induced currents. Predictive modelling of the potential impact of the Port on sediment movement indicated there would be a decrease in wave movement, and therefore a decrease in the amount of sediment moved in the lee of a vessel moored at the jetty. At the south of the jetty, the actual movement of sediment would slightly increase.

Changes in wave height directly inshore of a vessel moored at the jetty would result in changes to flows in the area near to shore, resulting in a change to the impact on the immediate beach. The environmental effects modelled showed that the jetty construction and operation would only affect the immediate local area around the jetty. No negative erosion, deposition or sedimentation impacts are predicted to occur at surrounding beaches or coastal areas outside the immediate area of the jetty, including Rogers Beach and Lipson Island.

Heritage and Native Title

A desktop review of Indigenous, European and maritime registered heritage sites in and around the Project area was undertaken as part of preparation for field based cultural heritage survey works. There are no registered heritage sites located within the Project area. At the time of the survey, the then Department of Environment and Heritage (DEH) records showed the listed *Three Sisters* maritime heritage site to be located in the immediate vicinity of the proposed jetty. Through research and field investigation it was identified this heritage site is actually located adjacent Lipson Island and not within the Project area. This was communicated to DEH and the site location amended in DEH records.

The proposed Port is not expected to impact on heritage values. There is potential for Indigenous heritage items to be exposed during construction earthworks. As part of construction preparation an Indigenous heritage monitor inspection would be undertaken of the proposed Stage 1 works areas, and cultural heritage management procedures would be developed and implemented as part of the overall construction management planning.

Visual

The Port is flanked to the north, west and south by rounded hills of approximately 50 m elevation, while the coastline to the north consists of a small bay with a sandy private beach, known as Rogers Beach. This is currently accessible by a dirt track through private land. The Port is surrounded by farmland with approximately 10 households within a 5 km radius of the site. Lipson Cove is approximately 1.5 km to the south of the site and a Crown Land coastal corridor approximately 50 m wide, extends along the eastern boundary of the Port. The site is not currently faced by any built formal tourism or recreational buildings however the shore is visible from Lipson Cove Beach but not the small informal camping ground present at the site, and from Rogers Beach which abuts the north of the site.

During the construction phase there is likely to be a slight visual impact of the jetty and buildings being constructed. Viewshed modelling was undertaken for operations phase and identified areas across the landscape that can be seen from different observation points reflecting the potential of the site to be viewed from recreational user areas, potential for views over larger landscape portions and accessible public areas with ease of access. Based on this five viewpoints were used for the model including Rogers Beach and Lipson Cove Beach.

The existing environment landscape was rated based on scenic quality and user sensitivity and then considered in the context of proposed Project infrastructure and activities. The assessment further considered the significance of this and identified impact significance rating ranging from negligible to moderate. While the Project would be visible, consideration of existing land uses and values were also included in the visual modelling impact assessment. The outcome of this assessment predicts the development's impact on visual amenity is not of high significance and would be negligible to moderate significance.

Stage 1 Port infrastructure would be constructed to consider reducing visual impacts to as low as reasonably possible by considered screening and infrastructure design. Existing topography was considered as part of engineering design and would provide screening to much of the onshore infrastructure from southern viewpoints. Infrastructure would be constructed with low visibility colours and vegetative native screening would be used along the southern boundary of Lipson Cove Road. Rogers Beach abuts the northern boundary of the site and, while the site would be visible, it is a private beach.

Decommissioning phases are expected to be decades in the future however removal of onsite infrastructure would be included in planning to redress potential visual impacts as well as other environmental risks.

Socio-economic

Port Spencer is located within the District Council of Tumby Bay (the District). The dominant industry within the District is agriculture, having the largest contribution to the economy and employment. Tourism is increasing in its contribution to the District economy. Other key economic sectors are fishing, aquaculture and mining. Tumby Bay is the main service centre for the District.

Potential socio-economic impacts will vary depending on the phase of development. During construction, it is predicted there would be an increased demand on local services and accommodation. This demand would decrease during the operational and decommissioning phases. The construction phase would have the largest workforce requirements, which would reduce during the operational phase. Centrex is committed to employing and procuring locally where possible. The Project offers significant export potential for mining and agricultural sectors in the region, which may also positively contribute to economic and employment development.

Management and Mitigation

A general environmental management framework for construction and operations is proposed based on the outcomes of the impact assessment. The framework provides the basic components of the proposed Construction Environmental Management and Monitoring Plan (CEMMP) and Operations Environmental Management and Monitoring Plan (OMMP).

An ISO14001:2004 *Environmental Management System* would be developed for the site as part of operations. The PER also proposes a number of specific environmental management and monitoring programs required for the Project, including, but not limited to, marine water quality, noise, air, site water management, marine pests, revegetation and rehabilitation, weeds, and waste. A detailed Emergency Response and Incident Management Plan, including maritime and terrestrial response processes and procedures would also be developed. It is noted that a suitably qualified commercial port operator would be appointed to manage Port Spencer, and be expected to develop and implement all required environmental, security and safety management procedures and processes.

Conclusion

The proposed Project location is considered to be a suitable site for a deep water commercial port facility based on consideration of potential social, environmental and economic impacts. It is considered that potential impacts can be managed effectively and the Project does not offer any unmanageable or extreme risks. The potential environmental, social and economic benefits of the Project offer significant opportunity to positively contribute to strategic development goals for both the Eyre Peninsula and South Australia. The Port also offers a significant private investment development that will allow Cape class vessels to export from the Eyre Peninsula, making it the first of its kind in the region.

The potential social, environmental and economic benefits and impacts of the Project were considered as part of this PER. Management and monitoring measures to both enhance potential benefits and mitigate potential negative impacts are identified. The Project's proposed design and layout has included consideration of sustainability principles including resource and energy efficiency, through water reuse, waste management and civil construction approaches, as well as ensuring the Project makes use of existing topography and considers colour and form to ensure visual impacts are minimised to the extent practicable along the coast. As a whole it is considered this multi-user Project offers significant opportunity to contribute to not only mineral and agricultural development, but the short and long term social and economic sustainability of the region and State through direct and indirect business, infrastructure, employment and contractor opportunities. The Project also aligns and supports key State and regional strategic development goals. In addition the Project offers the potential benefit to support population levels and growth in rural communities and townships.

It is considered the proposed private multi-user Port Spencer should be granted development approval.

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APPENDICES

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Port Spencer Stage 1 and Stage 2 Animation

APPENDIX B

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APPENDIX C

Air Quality Impact Assessment Report

APPENDIX D

Geotechnical Investigation and Soil Report

APPENDIX E

Environmental Site Assessment - Baseline Report

APPENDIX F

Surface water Conceptual Design and Management Report

APPENDIX G

Environmental Noise Assessment Report

APPENDIX H

Traffic Impact Assessment Report

APPENDIX I

Terrestrial Ecology Report

APPENDIX J

Lipson Island Terrestrial and Marine Ecology Report

APPENDIX K

Port Spencer Ecology Report

APPENDIX L

Sediment Transport Modelling Report

APPENDIX M

Cultural Heritage Report

APPENDIX N

Socio-Economics Baseline Report

APPENDIX O

Greenhouse Gas Calculations

1.0 INTRODUCTION

Centrex Metals Ltd (Centrex) is proposing to develop Stage 1 of a new deep water private multi-user port, Port Spencer (the 'Project' or the 'Port'). The Project is located on the east coast of Eyre Peninsula, South Australia, approximately 210 km north-west of Adelaide, 70 km north-east of Port Lincoln, 21 km north-east of Tumby Bay and 20 km south-west of Port Neill. This Public Environmental Report (PER) has been prepared pursuant to the provisions of section 46, '(Major Development)', of the *Development Act 1993* and the requirements of the project specific 2011 *Guidelines for the preparation of a Public Environmental Report, Sheep Hill Deep Water Port Facility (Stage 1) on Eyre Peninsula* (the 'Guidelines') prepared by the South Australian Development Assessment Commission (DAC). The Project, formerly referred to as Sheep Hill Port, was renamed Port Spencer in late 2011.

The Port would be constructed in Spencer Gulf with a view to exporting Centrex's iron ore from Eyre Peninsula and provide the mining industry with effective access to international markets. Centrex proposes to develop the site as a private multi-user bulk commodity export facility capable of accommodating Panamax (65,000 to 90,000 tonne capacity) and Cape class (165,000 to 200,000 tonne capacity) vessels. The Port would be suitable for export of up to 20 million tonnes of ore per annum (mtpa) from a single berth configuration and single ship loader. The Project also includes a road transport and infrastructure access corridor that would generally follow the alignment of the existing ungazetted Swaffers Road from Lincoln Highway. The Project may also serve as an export gate for grain and other mining companies in the Eyre Peninsula region.

Port Spencer would be developed in four stages, with Stage 1 (the 'Project'), the subject of this PER. Stage 1 would be constructed to allow the export of hematite and grain. Additional future stages would be developed, subject to separate Major Development applications, to allow for the export of magnetite (refer Section 1.2).

Investment in the Project is estimated to total approximately \$AUD250 million¹, including detailed design and construction of the jetty, outloading materials handling system and ship loader, site access, establishment of onsite services, and site preparation for fully enclosed receipt and storage facilities. A three dimensional electronic fly over of the proposed Port infrastructure is provided in Appendix A. The capital and operating cost of receipt and storage facilities would be the responsibility of each end user.

The location of the Project was selected on the basis of sea water depth to accommodate Cape class vessels without dredging, within a reasonable distance of the shore, and close proximity to Centrex's mineral reserves on the Eyre Peninsula. The current marine shipping facility at Port Lincoln poses challenges and limitations for Centrex on a number of aspects, including local development opposition and sensitive port use by Port Lincoln fisheries. Marine shipping facilities outside of the Eyre Peninsula, such as Port Adelaide or Darwin, are high cost transport options, which will result in larger operating costs and carbon footprints. It is anticipated the Port would reduce transportation costs and time, as well as the carbon footprint, of transporting minerals elsewhere for export.

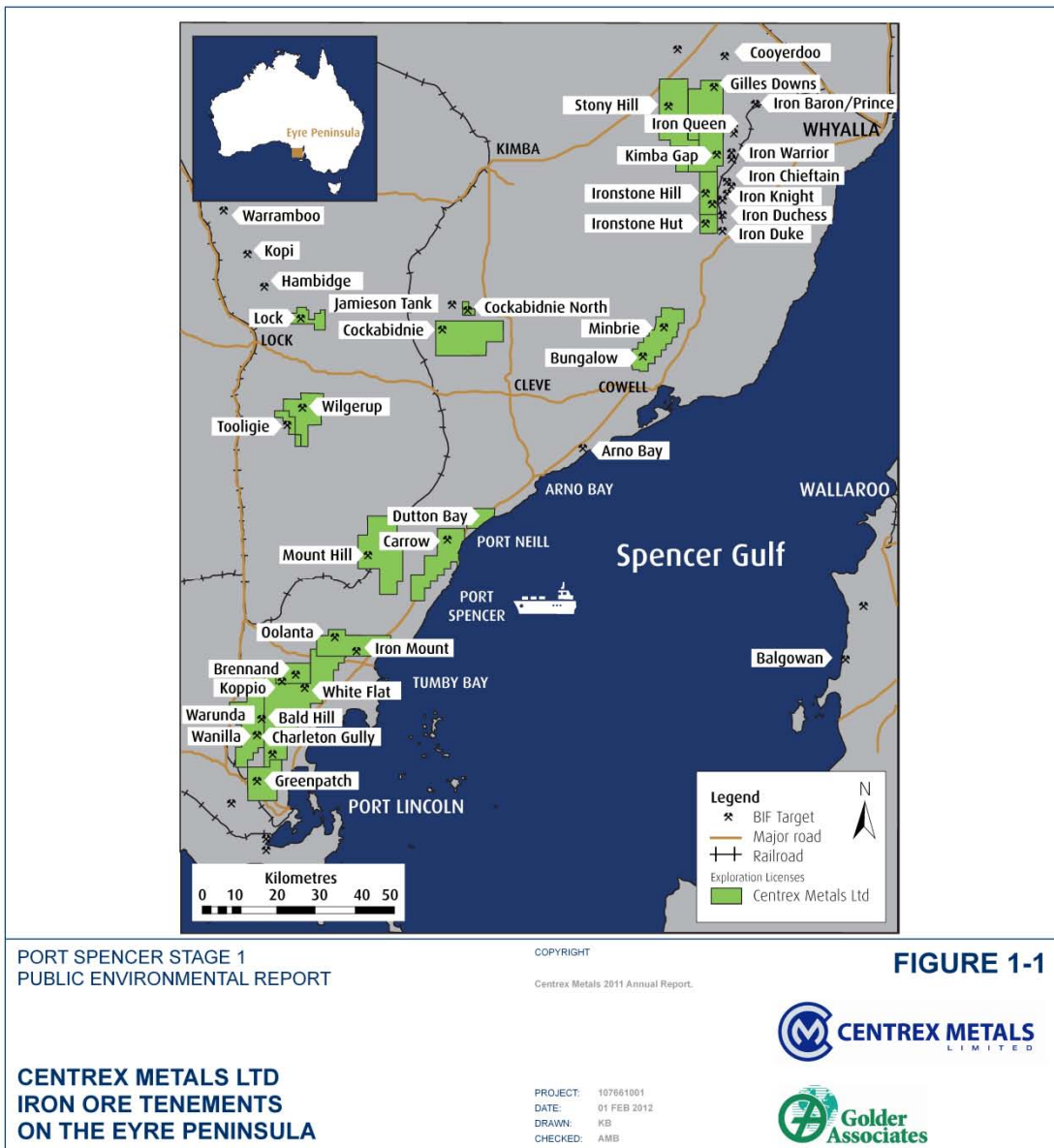
¹ The estimate of \$AUD250 million capital investment is provided with a possible 30% over or under spend provision.

1.1 Centrex Metals Ltd

Incorporated in 2001, Centrex is a publicly listed South Australian iron exploration and mining company. Centrex has extensive tenement holdings over iron ore resources and exploration targets on Eyre Peninsula in the southern Gawler Craton. They cover an area of 2,000 km² of iron ore deposits and prospects, including hematite and magnetite sources (Figure 1-1). The resources and targets are mainly within the early Proterozoic Middleback Subgroup sequence of banded iron formations (BIF) that host the historically important and currently operating iron ore mines of the Middleback Range (by OneSteel Ltd).

The extensive iron formations of Eyre Peninsula contain significant resources of hematite and/or magnetite BIF. Hematite is traditionally regarded as ‘direct shipping ore’ that can be exported without the need for beneficiation, while magnetite requires beneficiation (concentration with or without pelletising) to produce either iron concentrates or direct reduction grade iron ore pellets suitable for the export market.

Figure 1-1: Centrex Metals Ltd Iron Ore Tenements on the Eyre Peninsula



Source: Centrex Metals Ltd, 2011

Recently Centrex obtained approval to undertake mining at the Wilgerup hematite deposit, which will be one of a number of Centrex’s iron ore projects to be developed on the Eyre Peninsula in coming years. Other companies with mineral tenements and projects within the region include Eyre Iron Pty Ltd, IronClad Mining Ltd, Iron Road Ltd, Lincoln Minerals Ltd, Lymex Ltd, Minotaur Exploration Ltd, OneSteel Ltd, Samphire Ltd and Terramin Australia Ltd.

While resource demands continue to grow, particularly from China, there is increasing pressure for industry to plan for efficient transportation options, both from a carbon and energy efficiency perspective as well as reducing other transport impacts. Central to this is development of suitable infrastructure that can facilitate cost-effective and environmentally responsible transportation options for industry. The Project offers a significant regional opportunity to develop an alternative port and shipping option to Port Lincoln, and a localised option for the southern and mid-regions of Eyre Peninsula, reducing transport distances and improving the time taken to move product to market.

The primary contact details for this Project are detailed below:

Ms Alison Evans, Company Secretary	
Centrex Metals Ltd	Phone: (08) 8100 2200
Unit 1102, 147 Pirie Street	Fax: (08) 8232 0500
Adelaide, SA 5000	Email: admin@centrexmetals.com.au

1.2 Project Timing and Staging

The indicative schedule for Port Spencer Stage 1 development is presented in Table 1-1 below. Centrex recognises the decision on development approval is yet to be made but for the purposes of this document, it is assumed the development approval could potentially be granted in the second or third quarter of 2012.

Table 1-1: Indicative Port Spencer Development Schedule

Activity	Estimated Schedule	Status
Submission of draft Public Environmental Report to Government	Q4 2011	Complete
Submission of Public Environmental Report	Q1 2012	Complete
Project Development Approval	Q2/Q3 2012	Pending
Commencement of Construction	Q3 2012	Pending
Operation of the Project	Q4 2014	Pending

Port Spencer is proposed to be developed in four stages and this PER is for Stage 1 Project development only. The viability of the Project depends upon development approval for both Stages 1 and 2 of the Project and mining approvals for Centrex’s key magnetite mines. Port Spencer will not be constructed until these approvals are secured.

Figure 1-2 provides an indicative visual representation of the expected Port and mine development schedule. It should be noted this is indicative only and may alter in the future dependent on project changes. The following provides a brief summary of the key Port features proposed to be developed in each stage:

- Stage 1, Port development (refer section 4 for further details and Appendix A for a three dimensional electronic fly over of proposed Stage 1 infrastructure):
 - Jetty
 - Hematite and grain storage area
 - Ship loading area
 - Supporting Port infrastructure, and
 - Road access upgrades.
- Stage 2, magnetite development (2013-2015), (refer Appendix A for a three dimensional electronic fly over of proposed Stage 2 infrastructure):
 - Magnetite storage area and dewatering plant
 - Magnetite import from proposed mines via underground slurry pipelines, and
 - Desalination plant for mine operation and Port use.
- Stages 3 and 4, Port expansion, (post 2014):
 - Expansion of magnetite storage and processing, and
 - 1 extra hematite and grain storage shed respectively.

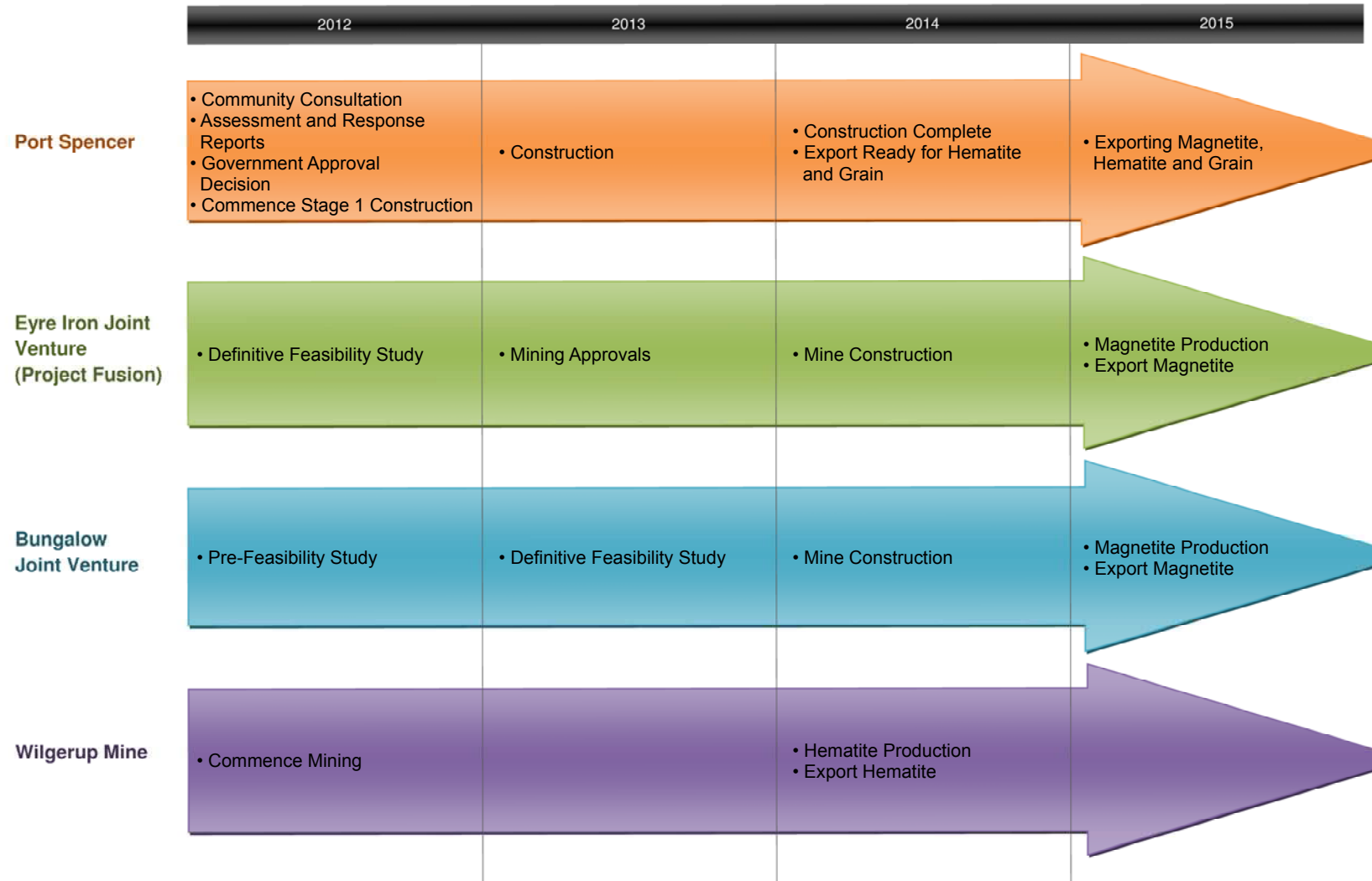
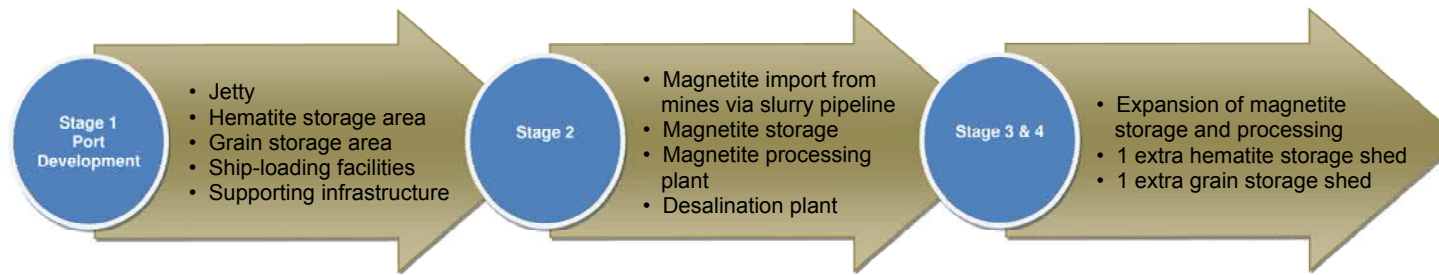
1.3 Public Environmental Report Process

This section outlines the development approvals process this Project is following under the provisions of the *Development Act 1993*. Figure 1-3 provides a visual summary of the process described below.

The purpose of the PER is to describe the Project and to address the issues outlined in the Guidelines (DAC, 2011). It evaluates the potential social, environmental and economic effects of the construction and operation of the Project and proposes mitigation, management and monitoring measures to address any potential adverse effects associated with development.

The PER considers the extent to which the expected effects of the development are consistent with the provisions of any Development Plan, the Planning Strategy and any matter prescribed by the Regulations under the *Development Act 1993* (refer Section 3).

INDICATIVE PORT AND
CENTREX MINE
DEVELOPMENT TIMELINE



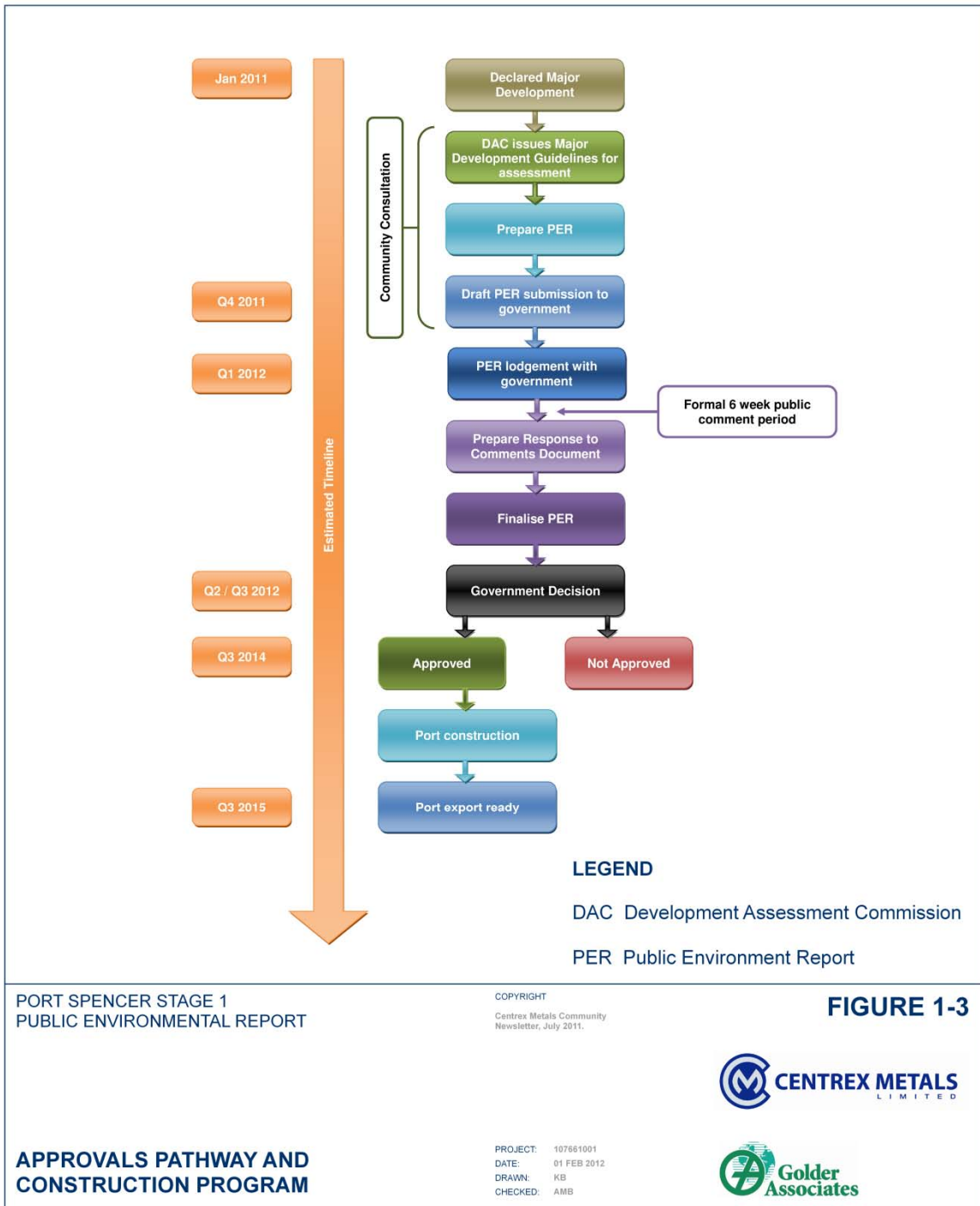
NOTE: This timeline is a current estimate only and may change in the future.

PROJECT: 107661001
DATE: 01 FEB 2012
DRAWN: KB / KRM
CHECKED: AMB

FIGURE 1-2



Figure 1-3: Approvals Pathway and Construction Program



Source: Centrex Metals Ltd, 2011

1 - Declaration as Major Development

A development proposal was submitted to the (then) Minister for Urban Development, Planning and the City of Adelaide on 7 December 2010 with a request for the project to be declared a 'Major Development' under Section 46 of the *Development Act 1993*. On 6 January 2011, the (then) Minister for Urban Development and Planning ('the Minister') made a declaration in the Government Gazette for the 'Sheep Hill'² Deep Water Port Facility proposal to be assessed as a Major Development under the provisions of Section 46 of the *Development Act 1993* (SA Gazette, 2011). Projects declared to have 'Major Development' status are considered to be of major environmental, social or economic importance to South Australia.

2 - Referral to the Development Assessment Commission for Setting of Assessment Level and Guidelines

On 18 February 2011, a Development Application and Request for Guidelines (Golder, 2011a) was submitted to the Development Assessment Commission (DAC). This document described the Project to enable DAC to consider the application and identify the social, environmental and economic issues relevant to assessment of the proposed development.

On 1 June 2011, following consultation with government agencies, the DAC issued *Guidelines for the Preparation of a Public Environmental Report for the Sheep Hill³ Deep Water Port Facility (Stage 1) on Eyre Peninsula* (Guidelines) (DAC, 2011). The Guidelines outlined Centrex's requirements for the preparation of a Public Environmental Report (PER) for the Port Spencer Stage 1 development. This level of assessment, sometimes referred to as a 'targeted Environmental Impact Statement', is applied by government where the issues surrounding the proposal require investigation in depth but are narrower in scope and relatively well known, or there is existing information available.

3 - Preparation and Release of the Public Environmental Report

This PER was prepared on behalf of Centrex by Golder Associates Pty Ltd. Under statutory requirements the PER will be released for public and regulatory agency comment for six weeks and made publicly available at the District Council of Tumby Bay and the Department of Planning, Transport and Infrastructure (DPTI)⁴. Early in the public exhibition period DPTI will facilitate a public meeting in an area close to the Project site in order to consult on the PER and proposed development.

4 - Responding to Public Comment

After the six week public comment period Centrex will be required to respond to public and regulatory agency comments. Centrex's *Response Document* will be released for public information and be available at the District Council of Tumby Bay and DPTI. The Response Document may include further information or amendments to the PER, or changes to the original proposal in response to issues raised. If substantial changes are made, further public exhibition may be required. The need for this would be identified at a future date, if applicable.

² In late 2011 Sheep Hill Port was renamed Port Spencer.

³ In late 2011 Sheep Hill Port was renamed Port Spencer.

⁴ The DPTI was previously known as the Department of Planning and Local Government (DPLG).

5 - Assessing the Proposal

The Minister (with the assistance of DPTI and other relevant government agencies) will assess the proposal, including the PER and Response Document, and detail the outcome of this assessment in a *Project Assessment Report*. The Assessment Report will be publicly released and made available at the District Council of Tumby Bay and DPTI. It is possible that a proposal may be refined in response to the Assessment Report.

6 – Decision

The Governor of South Australia will make a decision on the final proposal (on the advice of the Minister and Cabinet) having regard to the Assessment Report and other documentation. This decision will be notified in the Government Gazette and on the DPTI website, and notified to appropriate local media. The decision may take a variety of forms, including approving or rejecting the proposal, or approving with conditions attached. Some matters of detail may also be reserved for a later decision. There are no appeal rights against the decision of the Governor.

1.4 Community and Stakeholder Consultation

Centrex has undertaken progressive and regular engagement with communities of the Lower Eyre Peninsula who could be potentially impacted by the construction and operation of Port Spencer. Consultation has also included discussions with government regulators, industry bodies, local governments and local associations. This process has allowed time and opportunity for the views of all stakeholders to be considered as part of the technical studies, development and design of the Project. Centrex is committed to open and transparent communication with community and stakeholders.

Methods of engagement have included newsletters, stakeholder interviews, targeted consultations with key stakeholders, community information days and media releases. In August 2011, community concerns and questions about the proposed Port were shared among all stakeholders through the publication of a public *Stakeholder Response Report* (refer Appendix A).

1.4.1 Public Consultation

Commencing in 2008, periodic written contact was established through publication of Centrex newsletters called *Project Updates*. Newsletters are produced at times when new information about the project's progress is available. Past information has included:

- The Port's developing design and infrastructure
- Environmental and other studies being undertaken for the development application and environmental impact assessment process
- Centrex project team profiles
- Photographs and maps to illustrate ongoing work and plans for the site, and
- Project schedule and approvals processes.

Between December 2008 and December 2011 a total of six Project Updates were published, these are provided in Appendix B.

During 2011 Project Update issue numbers 4, 5 and 6 were posted through Australia Post directly to landowners along Swaffers Road and Lipson Cove Road and other stakeholders who had registered with Centrex to receive regular updates. These were also posted to all residents of Port Neill, Lipson and Tumby Bay using the Australia Post unaddressed mail delivery service.

Project Updates are published to the Centrex website (www.centrexmetals.com.au). Community feedback is invited from all interested persons to contact Centrex directly with their questions and concerns by telephone, mail or email.

Further newsletters will be published as the project continues through the PER process and into the future, should the project be approved by government and commence development.

1.4.2 Early Stakeholder Consultation and Community Interviews

Early Project consultation activities focussed on the following stakeholder groups:

- Neighbouring landholders to the Project site (Swaffers Road and Lipson Cove Road)
- Key State government stakeholders, including regulators, and
- Key local government stakeholders and regional development officers, especially District Council of Tumby Bay.

Senior Centrex project team members undertook informal consultation with neighbouring landholders. This process has led to consideration of local knowledge in the design of the Port and associated facilities, including open discussion about the most suitable routes for transport upgrades and pipeline infrastructure. A number of stakeholders indicated to Centrex they did not want to be engaged about the Port project. These stakeholders later participated in the 2011 broader community information days.

As part of 2008 baseline data collection for the socio-economic impact assessment (SIA) community interviews were conducted with residents of the Tumby Bay local area. The interviews were held in November 2008 and invited participants to nominate some of the values they attributed to the Tumby Bay area. Residents nominated the following as important values they ascribed to living in the area:

- Community spirit, familiar faces and friendly neighbours
- The quietness of the area
- Low levels of crime and high levels of safety
- Small-town lifestyle, and
- Clean, relaxed and stress-free environment.

The rural character and geographic beauty of the area was also identified as features of value to their lifestyle. Landscape features such as the Lipson Island Conservation Park and unspoilt beaches, including Rogers Beach, were nominated for their high community value (Golder, 2009a).

Centrex has accessed focus group results conducted for a Perceptions Analysis study for the Eyre Iron Joint Venture (Centrex/WISCO) development of the Carrow and Greenpatch mining projects. In February 2011 focus groups were held with participants from Port Lincoln, Port Neill and Tumby Bay and were made up of stakeholders from local government, local business and community representatives. The focus group results helped inform and direct the approach for broad community consultation, which is discussed in the following section. Specifically, stakeholders raised queries regarding environmental, aesthetic, social and economic concerns which were fed back into relevant studies and built into the preparation of information materials ahead of broader community consultation events.

1.4.3 Community Information Days

The January 2011 declaration that the Port would be considered a 'Major Development' triggered the next stage of Centrex's planned public participation activities. Broad community consultation events for the Project's potentially affected communities of Port Neill, Lipson, Tumby Bay and Port Lincoln were planned. A comprehensive Community Consultation Plan was designed for the Port's specific circumstances with objectives including building and maintaining stakeholder relationships, providing accurate and timely information about the Port's development and approvals process and seeking stakeholder feedback on key areas of interest.

In April 2011, Centrex hosted Project information days in Port Neill and Tumby Bay including attendance by senior Centrex project personnel. In early June 2011, Centrex hosted a similar event in Port Lincoln. Consultation was undertaken in the format of an open house information day. Community members were invited to attend at their own convenience during the advertised morning, afternoon and evening opening hours. Materials provided for information purposes at the consultations included:

- Past Project Updates (newsletters)
- A project information document prepared specifically for the consultation
- A three-dimensional fly over based on actual site spatial information and showing the expected visual impact of the Port development
- A series of seven posters providing information about Centrex, selection of the Project location, stages of Project development, government development approvals process and environmental studies, and
- Consultation feedback form.

More than 270 people attended the three events and more than 100 feedback forms were collected from attendees. Visitors to the information days in Port Neill and Tumby Bay were commonly retired town residents, local business operators, farmers, young parents, contractors and landowners from the Lipson Cove area. At Port Lincoln the visitors were commonly business operators and contractors, local industry leaders and members of local government.

The majority of feedback about the proposed Port was positive. Concerns were raised by attendees about site selection, potential environmental issues, and potential impacts on local traffic and power services. Opposition was expressed by some immediate neighbours to the proposed Port.

1.4.4 Stakeholder Response Report and Media Releases

A key outcome of the 2011 Port Spencer Community Consultation program was the publication of community questions and feedback in the form of a *Stakeholder Response Report* in August 2011. The responses provided in the written report aimed to provide the most up to date information and responses to queries raised. The report is provided in full as Appendix A. This was posted, using Australia Post, to all residents in Tumbly Bay, Lipson and Port Neill, and persons who registered with Centrex for mail out information. It was also published to the Centrex website.

Questions were categorised into the following themes:

- Site Selection and Alternatives
- Port Operating Facilities
- Port Support Infrastructure and Transport
- Mine Operations
- Employment and Training
- Approvals Process
- Environmental Impacts, and
- Community Consultations.

Centrex has made regular announcements to the media, particularly in compliance with its obligations for reporting to the Australian Stock Exchange. Media releases have also served an important function for informing interested stakeholders not geographically located near the site. People hearing about the Port Project through the media can visit the Centrex website to source further information and provide direct feedback to the company.

Key milestones for the publication of announcements have included:

- SA Government's announcement the Port was declared a 'Major Development' (6 January 2011)
- Development Assessment Commission's (DAC) release of Public Environmental Report Guidelines relating to the proposed Port (1 June, 2011)
- Confirmed re-naming of the proposed Port as Port Spencer (15 September 2011).
- Port Lincoln media were invited to a media call ahead of the community information event where the Centrex Managing Director was available to provide a full briefing on the Port's progress and answer questions.
- The Centrex Managing Director gave a presentation regarding the Port immediately following Centrex's AGM which was also released to the market (17 November 2011).

1.4.5 Government and Regulator Consultation

Since 2008, Centrex has met with local governments and regulators⁵, including but not limited to the following:

- Department for Manufacturing, Innovation, Trade Resources and Energy (formerly known as Department of Trade and Economic Development (DTED))
- Federal Department of Sustainability, Environment, Water, Population and Communities
- Development Assessment Commission (DAC)
- Environment Protection Authority (EPA)
- Department for Water (DFW) (formerly known as the Department for Water, Land and Biodiversity Conservation)
- Department of Environment and Natural Resources (DENR) (formerly known as Department for Environment and Heritage) including Coast Protection Board, Marine Parks, Parks SA, Native Vegetation Council and Maritime Heritage
- Department of Planning, Transport and Infrastructure (DPTI) (formerly known as Department of Planning and Local Government (DPLG) and Department for Transport, Energy and Infrastructure (DTEI))
- Department of Manufacturing, Industry, Trade Resources and Energy (DMITRE) (formerly the mining section was part of Primary Industries and Resources, South Australia (PIRSA))
- Department of the Premier and Cabinet (DPC)
- District Council of Tumby Bay
- District Council of Cleve
- City of Port Lincoln Council
- Lower Eyre Peninsula District Council
- Eyre Peninsula Regional Development Board (EPRDP)
- Eyre Peninsula Natural Resources Management Board (EPNRMB)
- South Australian Research and Development Institute (SARDI)

The purpose and structure of these meetings usually included an opportunity for Centrex personnel to present the current status of the development planning and project design and respond to any questions raised. In the case of regulators, the agencies would provide Centrex with advice on the company's obligations under South Australian and Commonwealth requirements as well as PER expectations.

⁵ It is noted that a number of government department names altered in late 2011. For the sake of clarity both former and current government department names are provided herein.

1.4.6 Summary of Stakeholder Issues

Table 1-2 presents a summary of key questions and concerns raised by stakeholders (including community, regulators, local governments and associations) and a corresponding reference to where the questions are addressed in this PER. As indicated above, the *Stakeholder Response Report* published by Centrex details all questions raised by community stakeholders during community information days held in April and June 2011 (refer Appendix A).

Table 1-2: Summary of Key Stakeholder Questions

Stakeholder Key Enquiry Summary	Stakeholder Group Raising Question or Concern	Relevant PER Section
Is the identified site the best place for the Port?	Community, local landowners, local government	Sections 2, 6 and 7
Is a new Port justified?	Regulators, community, local government	Section 2
How will the Port access power and water? Will local supplies be impacted by the Port's construction or operation?	Community, local government, regulators	Section 6.15
How will the Port impact on local traffic?	Community, local government, regulators	Sections 6.7 and 6.15
Will the public still be able to access Rogers Beach?	Community, local government	Section 6.15
Will there be any impacts on the birdlife of Lipson Island?	Community, local government, regulators	Section 6.10
How will the Port handle stormwater on site?	Regulators	Sections 6.3 and 7.3.5
What will the ships do with ballast water?	Community	Sections 6.8 and 7.3.10
Will there be employment and business opportunities out of the construction and operation of the Port?	Community, local government	Section 2
How will the lifestyle of our town be impacted?	Community	Section 6.15
Will we get new people (families) moving into our towns?	Community, local government	Section 6.15
What will the Port look like?	Community, local government, regulators	Section 6.14 and Appendix A
How long will the mining opportunities on the Eyre Peninsula last?	Community	Section 2
Will Centrex be willing to contribute to our communities?	Community, local government	Sections 6.15 and 7
Will there be any impacts from iron ore dust at the Port?	Community	Section 6.5

Stakeholder Key Enquiry Summary	Stakeholder Group Raising Question or Concern	Relevant PER Section
Where will the construction workforce be accommodated?	Local government, community, local business, regulators	Section 6.15
Will there be any impacts on other local industries such as tourism and aquaculture?	Local government, local business	Section 6.15
Who will buy the iron ore?	Community	Section 2
Will the Port put extra pressure on local health and emergency services?	Community, local associations, local government	Sections 5.15.4 and 6.15
Which mines will be developed first?	Community	Section 2

1.5 Structure of the Public Environmental Report

This PER identifies and discusses the potential environmental, social and economic impacts of the Project and proposes management and mitigation strategies to address these impacts. A brief description of the document's content is presented below:

- **Section 1** Background Port Spencer detail and context
- **Section 2** Project need, benefits and alternatives
- **Section 3** Planning analysis: describing how the construction and operation of the Project supports targets and objectives expressed in State Government strategic documents, and generally complies with the intent and provisions of the local Development Plan for the Project area.
- **Section 4** Description of the Project, including the nature and location of the development, a description of the Project and construction/commissioning timeframes.
- **Section 5** Information on the locality and existing environment, including terrestrial and marine environments as well as adjacent land uses
- **Section 6** Details of the anticipated environmental, social and economic effects of the proposed development
- **Section 7** A qualitative risk assessment of potential environmental and social impacts, proposed management, mitigation and monitoring measures
- **Section 8** Conclusion
- **Section 9** References consulted for this PER
- **Section 10** Glossary of terms and acronyms
- **Section 11** Acknowledgements

The PER appendices contain key detailed technical reports relevant to this document.

2.0 PROJECT NEED, BENEFITS AND ALTERNATIVES

This chapter of the Public Environmental Report (PER) addresses Sections 4.5.3 and 5.2 of the Guidelines (DAC, 2011) and discusses the need for Port Spencer and the alternatives that have been considered by Centrex Metals Ltd (Centrex).

2.1 Project Objectives

The Project has the following project development objectives:

- To provide an export route to market for Centrex's hematite and magnetite products arising from proposed mine developments on the Eyre Peninsula.
- To develop a socially acceptable, environmentally responsible and economically viable export route to market for Centrex related mining products.
- To provide for a private multi-user port option for third party iron ore and other export products from the Eyre Peninsula.
 - At this time, grain is the anticipated main secondary Port export product, and
- To positively contribute to the economic development of the Eyre Peninsula and South Australia.

2.2 Current and Predicted Iron Ore Demand

While the volume of iron ore exports from Australia is increasing each year much of this growth is based in the Pilbara region of Western Australia. South Australia is yet to capitalise on the potential for accessing iron ore demand from overseas markets. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) predicts Australia's iron ore exports will increase at least 7% each year to reach 599 million tonnes (Mt) in 2016. The June quarter 2011 ABARES Australian Commodities forecast estimated Australia would export 406 Mt in 2010/11.

Mineral resources on the Eyre Peninsula have attracted significant investment in mineral exploration, including from international sources. Centrex has entered into joint ventures with major Chinese steel makers Wuhan Iron and Steel Company (WISCO) and Baotou Iron & Steel (Group) Ltd (Baogang) to develop two of its projects (refer Table 2-1). WISCO and Baogang require their share of the magnetite to be produced by the proposed mines for use in their steel making businesses and it is expected they will also be customers for Centrex's share of the off-take.

Table 2-1: Centrex Iron Ore Projects

Project Name	Ownership Structure	Location	Iron Ore Type	Project Status
Wilgerup	100% Centrex	Approximately 22 km south-east of Lock	Hematite	Mining lease approval secured August 2011
Bungalow	Joint Venture: Currently 70% Centrex and 30% Baogang (with the potential for Baogang to earn up to 50% interest)	Approximately 12 km north of Cowell	Magnetite	Exploration Feasibility studies Environmental studies
Project Fusion	Joint Venture: 40% Centrex and 60% WISCO	Approximately 45 km from Port Spencer and inland from Tumbly Bay	Magnetite	Exploration Feasibility studies Environmental studies

Centrex holds a total of 16 iron ore tenements in the region and two tenements in New South Wales. Current projects in South Australia are listed in Table 2-2.

Table 2-2: Current Centrex Iron Ore Tenements on the Eyre Peninsula

Eyre Peninsula Sub-region	Tenement Location
Central Eyre Peninsula	<ul style="list-style-type: none"> ▪ Wilgerup ▪ Cockabidnie
Southern Eyre Peninsula	<ul style="list-style-type: none"> ▪ Greenpatch ▪ Koppio ▪ Vanilla and Whites Flat ▪ Bald Hill ▪ Iron Mount and Oolanta ▪ Carrow ▪ Mount Hill
Northern Eyre Peninsula	<ul style="list-style-type: none"> ▪ Bungalow ▪ Minbrie
Western Middlebacks	<ul style="list-style-type: none"> ▪ Stony Hill ▪ Kimba Gap ▪ Ironstone Hill ▪ Ironstone Hut

The viability of the Port from Centrex's perspective requires development of at least one of Centrex's magnetite projects. Centrex is currently undertaking feasibility studies for development of the mines and has commenced environmental studies to support mining lease applications for some of these projects. Mining approvals for development of the Wilgerup hematite mine were granted by DMITRE in 2011 and development of the mine will be scheduled to coincide with the development of the Project. Table 2-1 provides further detail on the projects likely to be developed first.

Other companies with iron ore mineral tenements and projects within the region include IronClad Mining Ltd, Iron Road Ltd, Lincoln Minerals Ltd, Lymex Ltd and OneSteel Ltd. While there are no formal arrangements currently in place for other users to access the Port, Centrex will be open to such arrangements, including providing land tenure for the establishment of additional facilities at the Project site, such as storage sheds. The viability of the Port will not depend on additional users accessing the site.

At this stage, Iron Road Ltd has expressed interest in using the Port for the export of magnetite and there has been significant interest from the grain industry. It is estimated that 500,000 tonnes of grain could be shipped from the Port following the first stage of development. Third party users would be responsible for development of their own on-shore infrastructure.

The Project provides significant opportunity to support South Australia's iron ore industry and would enable Centrex's development of iron ore deposits within the Eyre Peninsula.

2.3 Port Spencer: 'Do Nothing' Option

The viability of mining on the Eyre Peninsula is not certain and the cost of transporting product to markets is a significant influencing factor when considering the feasibility of each project. Centrex's Wilgerup hematite project has approvals in place to commence mining, and the economic viability of this project, and many after it, would be greatly influenced by a decision not to proceed with the Project. Without the Port, Centrex's mine development would be hindered and it may preclude progression of some of its iron ore deposits to operating phase. There are no alternative options based on existing port operations or other port sites (refer Section 2.6) that are considered feasible with Centrex's current mine development schedules and commercial considerations.

If the Project was not developed transport options for developing mines would require significantly longer haulage routes and associated fuel and haul costs, which would put pressure on the economic viability of each project as it is assessed for feasibility. In addition, larger carbon footprints associated with longer transport routes contribute environmentally, but also potentially economically, on project viability.

More broadly, the Eyre Peninsula and South Australia would lose a significant opportunity to gain a new piece of major transport infrastructure, which would be available to multiple users and funded entirely by private enterprise. The "do nothing" option would see the region and State miss out on opportunities and benefits arising from the Project and related potential mine development including the following:

- Significant private investment of approximately \$AUD250 million capital costs
- Approximately 200 construction jobs
- Approximately 70 operational jobs
- State revenue from taxes and royalties
- Flow-on economic benefits including:
 - Additional exports in excess of \$AUD357 million per year (Stage 1 only)
 - Increases in South Australia's gross state product
 - Accelerated development of iron ore projects in proximity to Port Spencer

- Increased demand for goods and services, stimulating business development and employment in the local government area and Eyre Peninsula region, and
- Diversified regional economic base and improved economic outlook.

2.4 Project Justification and Potential Benefits

The justification for this Project can be summarised as follows:

1. Alternative existing ports on Eyre Peninsula and elsewhere in the State cannot meet the requirements for developing iron ore projects on Eyre Peninsula.
2. Developing iron ore projects may not be commercially viable without a suitable transport route to market in close proximity to resource locations., and
3. The Project scale is proposed to meet Centrex's current expected export volume demands while allowing for the most flexible options for other potential Port users and third parties.

The capital cost, in monetary terms, for developing the Project is approximately \$AUD250 million⁶. This would be raised entirely through private resources and Centrex would also contribute the major capital costs required for the expansion of public utilities, such as power and water, to service the Port (refer Section 6). It is intended that Centrex would pay for the power spur line, not for the upgrade of the main 132kv Eyre Peninsula transmission however, the development of the Project and associated mines has the potential to bring forward the scheduled electrical transmission upgrade by several years. This is a significant private investment, which offers financial benefits to not only other businesses on the Eyre Peninsula through improved transport, power and water infrastructure but the State Government, by removing the need for any capital taxpayer investment in Port development.

Other non-monetary and non-physical costs have also been considered as part of this PER. These primarily relate to lifestyle and amenity impacts which are anticipated to be strongest for neighbouring residents to the proposed site and those living in nearby towns. The preferred location for the Port was selected for its position away from populated areas to reduce these types of impacts and is not located in the immediate vicinity of residences. A more detailed discussion about impacts on amenity can be found in Section 6.

Centrex is committed to the provision of local, regional and state benefits from the construction and operation of the Port. Table 2-3 provides a summary of the key potential benefits identified through the research and assessments conducted for this PER. Further information on each benefit can be found at the reference provided.

⁶ The estimate of \$AUD250 million capital investment is provided with a possible 30% over or under spend provision

Table 2-3: Potential Project Benefits

Geographic Extent Category	Description of Benefit	Relevant PER Section
Local	Local and regional employment and training opportunities during construction and operations.	Section 6.15
	Increased local investment and flow-on economic benefits to local townships.	Section 6.15
	Moderate local population growth, including additional school enrolments.	Section 6.15
	Potential business opportunities for local suppliers or contractors to provide goods or services to the Port during construction and operations.	Section 6.15
	Road upgrade and sealing of Lipson Cove Road, Swaffers Road and Lincoln Highway intersections.	Sections 6.7 and 6.15
Regional	Additional transport and export route options for grain producers and other miners with reduced transport costs associated with decreased road and rail travel requirements (i.e. to Adelaide or other facilities outside the Eyre Peninsula).	Section 6.15
	Access to Cape class vessels for export of regional product: currently Eyre Peninsula shipping options are restricted and do not include Cape class size options.	Section 6.15
	Development of regional mining as a new industry: increasing commercial viability of mining projects through reduced transport costs.	Section 6.15
	Additional demand for power arising from the Port and other mine projects is likely to result in early upgrade of the regional electricity network thereby contributing to improving security of supply for the region.	Section 6.15
	Provision of an alternative shipping option to Port Lincoln, which has vessel size and port capacity restrictions and pressures from surrounding community and businesses.	Section 6.15
	Increased regional investment and flow-on economic benefits including potential for new employment and business opportunities.	Section 6.15
State	As a private financial investment the Project offers a major addition to state transport infrastructure at no cost to government.	Section 6.15
	<p>Port development aligns with the objectives of the <i>South Australian Strategic Plan 2011</i> (SASP, 2011) including regional requirements:</p> <ul style="list-style-type: none"> ▪ Growing prosperity: employment growth, business development and diversifying the State's industry base (SASP, 2011): <ul style="list-style-type: none"> ▪ Goal: South Australia has a resilient, innovative economy. <ul style="list-style-type: none"> • The Port would contribute to the following targets directly; Target 35: Economic Growth and Target 37: Increase the value of total export ▪ Goal: We develop and maintain a sustainable mix of industries across the state. <ul style="list-style-type: none"> • Target 41 (minerals exploration) and Target 42 (minerals production and processing): By providing a transport option that would potentially improve the commercial viability of mine development on the Eyre Peninsula, and the Port's required 	Section 3

Geographic Extent Category	Description of Benefit	Relevant PER Section
	<p>development for Centrex mine options the Project would contribute to these key State Strategic Plan targets.</p> <ul style="list-style-type: none"> ▪ Goal: South Australia’s transport network enables efficient movement by industry and the community. <ul style="list-style-type: none"> • Target 56 Strategic Infrastructure: Ensure the provision of key economic and social infrastructure accommodates population growth. This project would contribute to regional infrastructure that has potential to support current and future populations in the region. ▪ Environment: Addressing climate change, looking after our natural environment (SASP, 2011) <ul style="list-style-type: none"> ▪ Goal: We reduce our greenhouse gas emissions. <ul style="list-style-type: none"> • Target 59: Greenhouse gas emissions reduction. This Project offers a transport option to contribute to reducing overall mining and other industry related emissions arising from road transport. (It is noted, that transport related greenhouse gas reductions are relative to the fact that the development and operation of the Port will generate new GHG emissions.) ▪ Our ideas: innovation, creativity and education (SASP, 2011) <ul style="list-style-type: none"> ▪ Goal: In South Australia we encourage entrepreneurship and enterprise in business. <ul style="list-style-type: none"> • Target 94: Venture capital: Achieve a cumulative total of 100 private equity investments into South Australian companies between 2011 and 2020 (baseline: 2010-11). This Major Development will be 100% privately funded and therefore is contributing to business enterprise development and innovation in South Australia. 	
	<p>The Port development aligns with the State <i>Strategic Infrastructure Plan for South Australia 2004/5 – 2014/15</i> (Office for Infrastructure Development, 2005):</p> <ul style="list-style-type: none"> ▪ Electricity supply capacity: <ul style="list-style-type: none"> ▪ This Project, through private investment in power corridors, would facilitate power upgrades that may benefit the wider Eyre Peninsula district. ▪ Transport requirements for mining developments in the Gawler Cratons: facilitate the development of infrastructure to support viable mines <ul style="list-style-type: none"> ▪ This Project would significantly contribute to the potential support of ,mining developments in the region. 	Section 3
	<p>The Port will support development of mining for the State, thereby contributing to potential increased economic development and prosperity.</p>	Section 6.15
	<p>Employment opportunities for skilled workers, contractors and suppliers.</p>	Section 6.15
	<p>Reduced transport related carbon emissions, compared to feasible alternatives, due to reduced road haulage options and use of larger Cape class vessels (reduction of shipping frequencies). This supports South Australia’s GHG Strategy 2007-2020 and goals to reduce carbon emissions.</p>	Section 6.1

2.5 Project Development Stages

This PER applies to the proposed Port Spencer Stage 1 development as described in Section 1.2.

The Project is proposed to be undertaken in Stages to reflect expected Centrex mining export requirements over time. This staged approach allows a more balanced investment with regard to capital expenditure and would facilitate Port development in the shorter rather than long term. Design has factored future expansion potential into the layout to provide maximum flexibility in options for transport and infrastructure location. This means a staged approach does not restrict future development options, which may become commercially viable in the future.

Rather than waiting for all mine projects to develop at the same time, the Port can be developed to meet Wilgerup mine and other party needs. This provides the additional benefit of other potential Port users being able to export in the shorter term.

2.6 Project Site Selection

The decision process leading to the identification of Port Spencer as Centrex's preferred location is discussed further in the following text.

2.6.1 Alternative Existing Ports

Existing ports and alternative routes to market were considered as part of the early planning and feasibility studies for this Project. Seven alternative ports were considered including Port Lincoln, Whyalla, Port Pirie, Thevenard, Port Adelaide and the proposed Port Bonython. The sites of existing port locations are shown on Figure 2-1 and alternative site locations are shown on Figure 2-2.

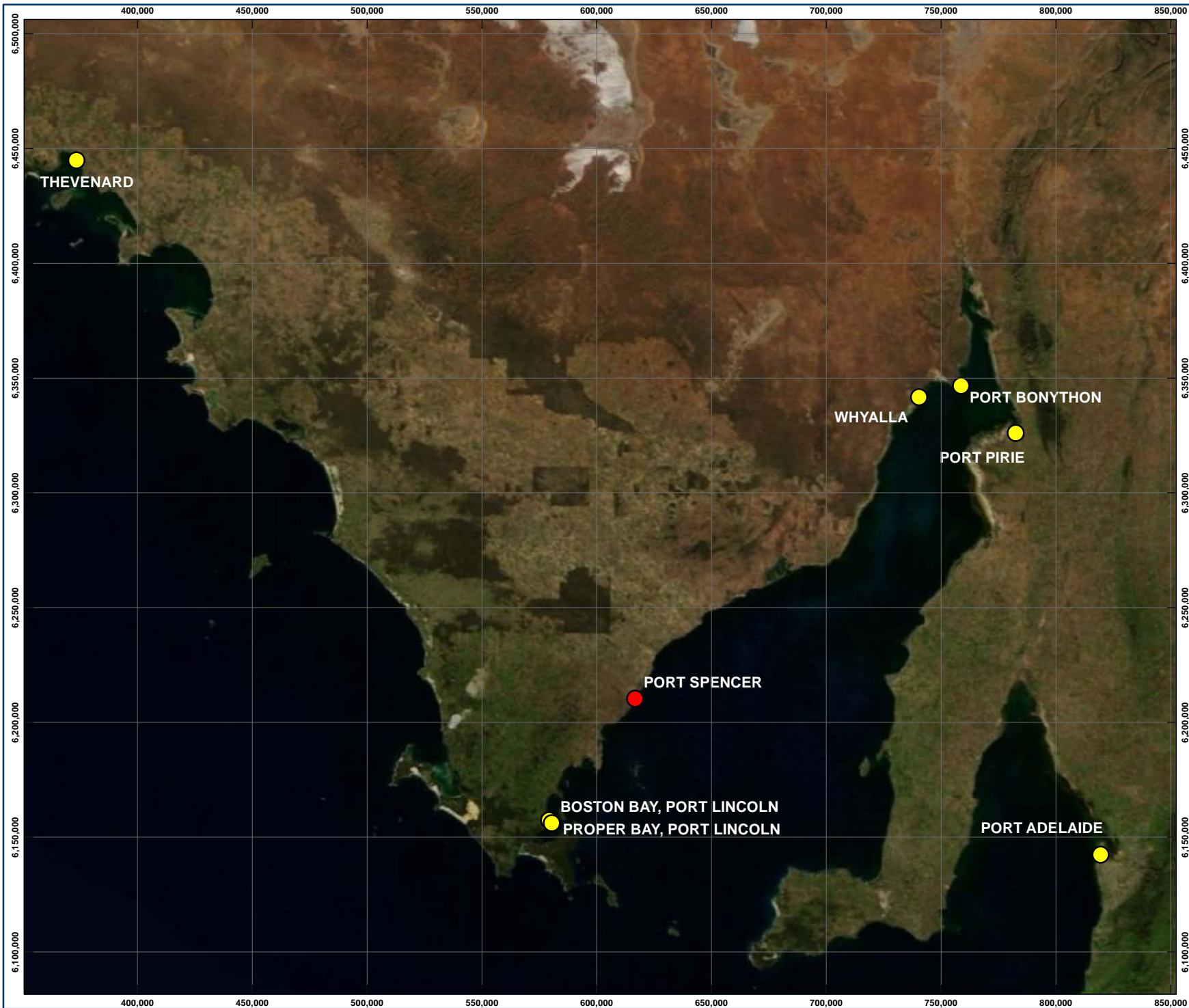
Existing ports were assessed against the following criteria:

- Navigable water to accommodate a fully laden Cape class vessel (165,000 to 200,000 tonne capacity) at low tide with no draft restriction and no requirement for dredging
- Proximity to iron ore resources and targets on the Eyre Peninsula
- Potential environmental impacts (including comparative advantages/disadvantages between the sites)
- Economic impact on mine development
- Existing port terminus congestion
- Likely community support for development, expansion or use of existing port facilities, and
- Availability of suitable land for purchase for any future new port development.

The outcome of the ranking process was to identify an existing port that was considered to be potentially economically viable while also being the least socially and environmentally sensitive and to also provide Centrex with an opportunity to contribute to the sustainability of the local and regional community. The results of the assessment including the assessment criteria are summarised in Table 2-4.

The summary results of this assessment were:

- Port Pirie and Port Adelaide are not considered economically viable due to:
 - The high cost of transporting product by road.
 - The limited access to rail from these ports to Centrex deposits., and
 - Insufficient water depth to accommodate Cape class vessels.
- Thevenard cannot accommodate Cape class vessels and is unlikely to have the capacity to meet Centrex's needs.
- Whyalla operates a bulk-loading barge transfer operation, but is indentured for use by OneSteel. This port is unlikely to be available to meet Centrex needs.
- Port Lincoln is not considered a long-term solution for mineral shipment due to issues including:
 - Community opposition
 - Increased traffic congestion in a built-up area from road transport of minerals
 - Congestion at the port with existing grain shipments
 - Sensitivities of nearby fisheries and aquaculture industries, and
 - Lack of ore storage facilities and available land to develop them.
- Proper Bay requires significant upgrading to operate as a viable barge transfer operation and is not considered a viable option by Centrex.



**EXISTING PORT
LOCATIONS IN SOUTH
AUSTRALIA**

LEGEND

- Existing Port Locations
- Port Spencer

COPYRIGHT

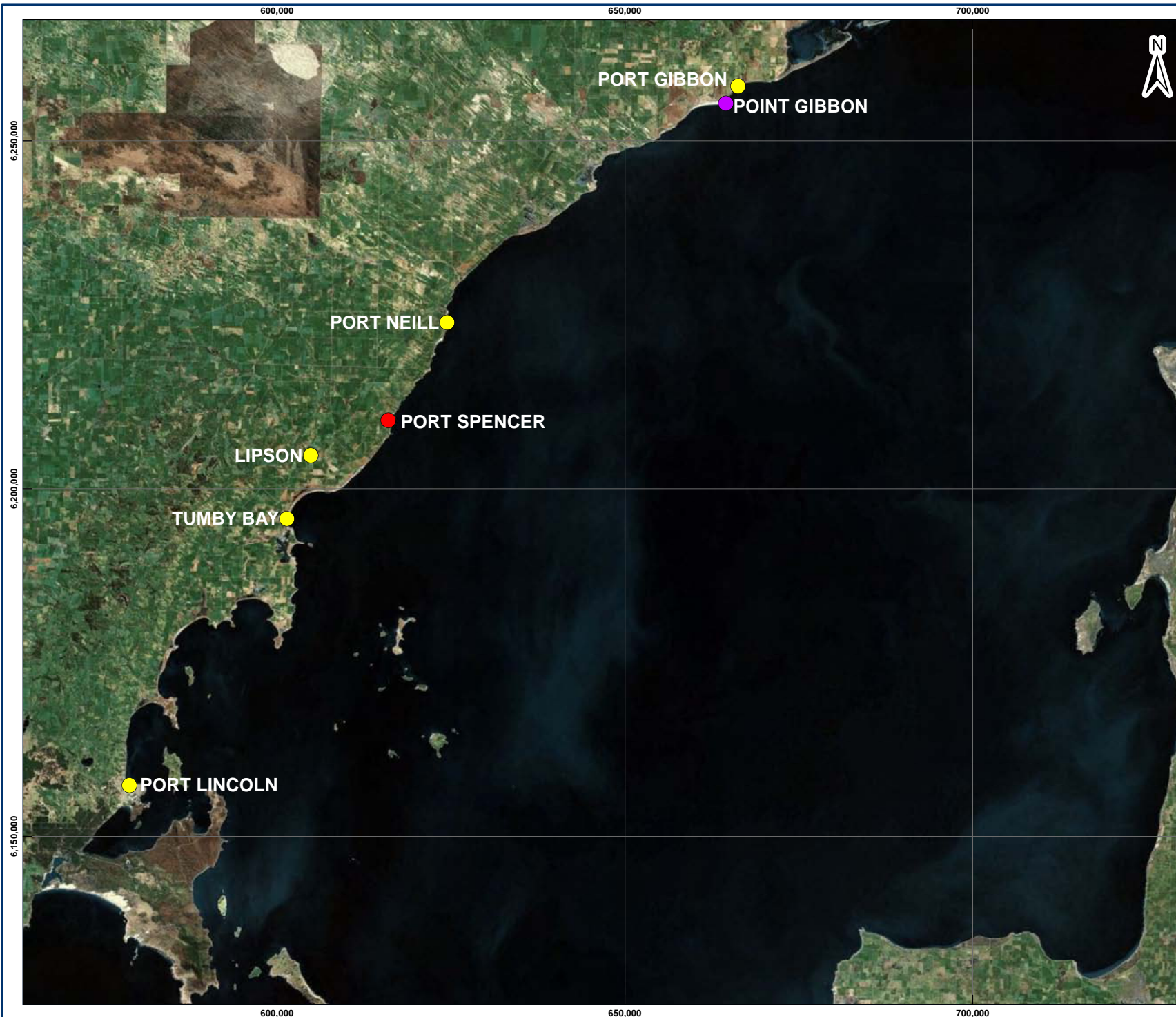
bing
 (c) 2010 Microsoft Corporation and its data suppliers.
 Aerial image sourced from Bing Maps, date sourced 21.12.2011.
 Township data sourced from MapInfo StreetPro.

0 5 10 20 30 40 50 kilometres
 SCALE (AT A4) 1:2,250,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB / KRM
 CHECKED: AMB

FIGURE 2-1





PROJECT ALTERNATIVE
SITE LOCATIONS



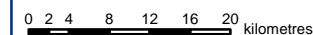
LEGEND

- Township
- Alternative Site Considered for New Port
- The Project

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Aerial image sourced from Bing Maps, date sourced 21.12.2011.
Township data sourced from MapInfo Street Pro.



SCALE (AT A4) 1:750,000
DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
DATE: 01 FEB 2012
DRAWN: KB / KRM
CHECKED: AMB

FIGURE 2-2



Table 2-4: Assessment of Existing Port Options within South Australia

Whyalla	Port Bonython (proposed new bulk commodities port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln	Thevenard	Port Pirie	Port Adelaide
Criteria: Cape Class Vessel capability						
<p>Unlikely to be suitable</p> <p>It is a bulk-loading barge trans-shipment operation. The harbour has five berths capable of handling vessels up to 40,000 t for bulk discharge, and vessels up to 65,000 t for the loading of iron ore.</p> <p>Constraints:</p> <ul style="list-style-type: none"> Shallow water not suitable for servicing fully laden Cape class vessel. Trans-shipment required. Onesteel privately owned port and unavailable to Centrex. 	<p>Potentially suitable</p> <p>Spencer Gulf Port Link Consortium is planning a new bulk commodities port at Port Bonython to accommodate Cape class vessels.</p> <p>Constraints:</p> <ul style="list-style-type: none"> Still in planning stage. Unlikely to be constructed until at least 2015. Does not meet Centrex's schedule needs. Potential environmental sensitivities associated with port expansion. 	<p>Unlikely to be suitable</p> <p>Trans-shipment from barges (or similar) to Cape class vessels required. Trans-shipment occurs 9 nautical miles from Proper Bay in water depths greater than 20 m.</p> <p>Constraints:</p> <ul style="list-style-type: none"> Trans-shipment required. Shallow water not suitable for servicing fully laden Cape class vessel (165,000 to 200,000 t capacity) at low tide with no draft restriction. 	<p>Unlikely to be suitable</p> <p>Panamax capable (80,000 t) at Berth 4. Potential rail network utilisation from Wilgerup. Could use Berth 9 and undertake trans-shipment.</p> <p>Constraints:</p> <ul style="list-style-type: none"> Trans-shipment required (for Cape class). Shallow water not suitable for servicing fully laden Cape class vessel (165,000 to 200,000 t capacity) at low tide with no draft restriction. 	<p>Unlikely to be suitable</p> <p>Constraints:</p> <ul style="list-style-type: none"> Shallow water not suitable for servicing fully laden Cape class vessel (165,000 to 200,000 t capacity) at low tide with no draft restriction. 	<p>Unlikely to be suitable</p> <p>Constraints:</p> <ul style="list-style-type: none"> Shallow water not suitable for servicing fully laden Cape class vessel (165,000 to 200,000 t capacity) at low tide with no draft restriction. 	<p>Unlikely to be suitable</p> <p>Constraints:</p> <ul style="list-style-type: none"> Shallow water not suitable for servicing fully laden Cape class vessel (165,000 to 200,000 t capacity) at low tide with no draft restriction.
Criteria: Proximity to iron ore resources and targets*						
<p>Not assessed since access not available</p>	<p>Potentially suitable</p> <p>Approximately 220 km to Centrex targets of interest.</p>	<p>Suitable</p> <p>Approximately 184 km to Centrex targets of interest.</p>	<p>Suitable</p> <p>Approximately 179 km to Centrex targets of interest.</p>	<p>Unlikely to be suitable</p> <p>Approximately 314 km to Centrex targets of interest.</p>	<p>Unlikely to be suitable</p> <p>Approximately 490 km to Centrex targets of interest.</p>	<p>Unlikely to be suitable</p> <p>Approximately 660 km to Centrex targets of interest.</p>

Whyalla	Port Bonython (proposed new bulk commodities port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln	Thevenard	Port Pirie	Port Adelaide
Criteria: Environmental impact						
<p>Not assessed since access not available</p>	<p>Potentially suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Construction of new port will create an environmental impact. ▪ Significant distances for road transport required contributing to increased greenhouse gas emissions. ▪ The roads may not withstand the required ore volumes contemplated. ▪ The rail systems are not connected and are of different gauge. 	<p>Potentially suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Road transport required contributing to increased greenhouse gas emissions. ▪ Aquaculture and environmental reputation impacts. ▪ Dust and noise potential through residential areas. 	<p>Potentially suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Road transport required contributing to increased greenhouse gas emissions and vehicular traffic. ▪ Traffic movement through the City of Port Lincoln during grain harvesting is already congested and potentially dangerous due to the increasing volume of large trucks (often A-Doubles) and adding mining to the equation will add to the problem. ▪ The development of an alternative heavy vehicle route into Port Lincoln is becoming more expensive and less likely as expansion and sub division of land occurs on the city outskirts. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Significant distances for road transport contributing to increased greenhouse gas emissions and operating costs. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Significant distances for road transport contributing to increased greenhouse gas emissions and operating costs. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ Significant distances for road transport contributing to increased greenhouse gas emissions and operating costs.

Whyalla	Port Bonython (proposed new bulk commodities port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln	Thevenard	Port Pirie	Port Adelaide
Criteria: Economic impact						
<p>Not assessed since access not available</p>	<p>Potentially suitable Proposed \$AUD600 million development: includes 3 km jetty, rail connection, intermodal and onshore storage facilities. The project is proposed to be privately funded. Constraints:</p> <ul style="list-style-type: none"> ▪ Capital cost to join and upgrade rail networks from Centrex interest deposits would be ~\$AUD450 million. ▪ Operating cost of ~\$AUD15/t to rail product ~220 km to Port Bonython is substantial. For a 5 Mtpa operation in southern Eyre Peninsula it would add an additional ~\$AUD75 million in operating costs per year over the life of project. ▪ Port Bonython construction schedule to be confirmed. 	<p>Potentially suitable High capital expenditure required: refurbishment required (shed, wharf upgrade, vessel loader and train unloader). Constraints:</p> <ul style="list-style-type: none"> ▪ Relies on trans-shipment. Potential for weather delays in trans-shipment loading with high costs. 	<p>Not suitable High-range capital expenditure required (ship loader, train unloader) and new ore storage shed Constraints:</p> <ul style="list-style-type: none"> ▪ Relies on trans-shipment. Potential for weather delays in trans-shipment loading with high costs. ▪ Existing grain shed not available for conversion to ore storage shed. ▪ No land available near the jetty to allow construction of a new shed. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ High road transport costs. ▪ Cape class vessel constraints. ▪ Relies on trans-shipment. Potential for weather delays in trans-shipment loading with high costs. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ High road transport costs. ▪ Cape class vessel constraints. Relies on trans-shipment. Potential for weather delays in trans-shipment loading with high costs. 	<p>Unlikely to be suitable Constraints:</p> <ul style="list-style-type: none"> ▪ High road transport costs. ▪ Relies on trans-shipment: Potential for weather delays in trans-shipment loading with high costs.

Whyalla	Port Bonython (proposed new bulk commodities port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln	Thevenard	Port Pirie	Port Adelaide
Criteria: Terminus congestion						
<p>Not assessed since access not available</p>	<p>Potentially suitable New development proposed is an open access facility. Constraints: <ul style="list-style-type: none"> ▪ Will need to negotiate and secure access, alongside many other companies wishing to use the port. </p>	<p>Potentially suitable Lease - Centrex Currently not utilised for exporting. Constraints: <ul style="list-style-type: none"> ▪ Busy port with large commercial fishing fleet, issues may include fleet congestion and potential impacts on other significant industry. </p>	<p>Potentially suitable Lease - Flinders Ports Pty Ltd. Current principal commodity exports comprise grains and seeds, petroleum products and fertilisers. Constraints: <ul style="list-style-type: none"> ▪ Busy port with large commercial fishing fleet, issues may include fleet congestion and potential impacts on other significant industry. </p>	<p>Potentially suitable Lease - Flinders Ports Pty Ltd. Current principal commodity exports comprise gypsum, grains and seeds and salt. Constraints: <ul style="list-style-type: none"> ▪ Approximately 130 ships per year are loaded. Limited options for increased shipping numbers. </p>	<p>Potentially suitable Lease - Flinders Ports Pty Ltd. Current principal commodity exports comprise grains and seed, mineral concentrates, coal, smelter outputs (zinc and lead) and general cargo. Constraints: <ul style="list-style-type: none"> ▪ Approximately 60 ships per year are loaded. Potential limitations for capacity for volume of ships per year. </p>	<p>Potentially suitable Lease - Flinders Ports Pty Ltd. Current principal commodity exports comprise grains and seeds, limestone, petroleum products, soda ash, motor vehicles, containers, metals and metal scrap, cement products, fertilisers, agricultural products, iron and steel, livestock, break-bulk and general cargoes, mineral sands and mineral concentrates. Constraints: <ul style="list-style-type: none"> ▪ Approximately 420 dry bulk ships per year are loaded. </p>

Whyalla	Port Bonython (proposed new bulk commodities port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln	Thevenard	Port Pirie	Port Adelaide
Criteria: Community support [#]						
Not assessed since access not available	Potentially suitable due to boost provided to local economy Constraints: <ul style="list-style-type: none"> ▪ Public concerns about environmental impacts. ▪ Increased traffic on local roads. 	Unlikely to be suitable Constraints: <ul style="list-style-type: none"> ▪ Community opposition: sensitive port use by the fisheries in Port Lincoln and increased traffic through the city. Community would prefer this option not be used. 	Although Centrex has approval to export from this location it is Unlikely to be suitable Constraints: <ul style="list-style-type: none"> ▪ Community opposition: sensitive port use by the fisheries in Port Lincoln and increased traffic through the city. ▪ Potential impact on other port users. Cargo compatibility (grain versus iron ore perception). Need to co-exist with another significant industry. 	Suitable since existing commercial port.	Suitable since existing commercial port.	Suitable since existing commercial port.

* For reference purposes distances were calculated from the Centrex Wilgerup mine located 21 km south-east of Lock and approximately 17 km east of the railway to Port Lincoln. Distance suitability assessment (based upon transport route distances):

- Distances greater than 250 km were considered 'Unlikely to be suitable'.
- Distances greater than 150 km and less than 250 km were considered 'Potentially suitable'.
- Distances less than 150 km were considered 'Suitable'.

[#] These statements are assumptions based upon local knowledge since formal community consultation has not been undertaken for all locations.

2.6.2 Site Selection

Once it was established that existing Ports poorly met Centrex requirements, site selection evaluations were undertaken for two sites (refer Figure 2-2) on the eastern side of the Eyre Peninsula:

- Port Spencer, located approximately 21 km north-east of Tumby Bay, and
- Point Gibbon, located approximately 85 km north-east of Tumby Bay and approximately 20 km south-west of Cowell.

Potential sites were considered based on a number of key criteria:

- Navigable water to accommodate a fully laden Cape class vessel (165,000 to 200,000 tonne capacity) at low tide with no draft restriction
- Suitable land; including available area, terrain, geotechnical conditions, ownership, availability of utilities, and road access
- Proximity to iron ore resources and targets on the Eyre Peninsula
- Potential environmental impact, including comparative advantages/disadvantages between the sites
- Potential economic impact
- Likely community support
- Local government support, and
- Development cost, including the differential costs of land purchase, site preparation, road access, and utilities supply.

The desired outcome of the site ranking process was to identify a site for a new port that was considered to be potentially economically viable, the least environmentally sensitive and to provide Centrex with an opportunity to contribute to the sustainability of the local and regional community. The results of the assessment are presented in Table 2-5.

Table 2-5: Port Spencer and Point Gibbon Site Assessment Summary

Criteria	Port Spencer	Point Gibbon
Cape class capability	●	●
Suitable land	●	●
Proximity to iron ore resources and targets	●	●
Potential environmental impact	●	●
Potential economic impact	●	●
Community support	●	●
Local government support	●	Not assessed
Development cost	●	Not assessed

Legend: ● Unlikely to be suitable ● potentially suitable ● Suitable

The summary results of this assessment were:

- Port Spencer provides access to deep water within 515 m to the shore;
 - Jetty construction is estimated to cost approximately \$AUD100 million for each 500 m. This makes Port Spencer a much more economical option than Point Gibbon, where the jetty would have to be approximately 2 km long to reach deep water.
- Marine impacts at Port Spencer would be minimised by access to deep water without dredging.
- Port Spencer has existing transport routes to the site and access to Lincoln Highway, which can be upgraded for Port operation.
- The land at Port Spencer is significantly degraded from previous agricultural use, minimising the potential for environmental impacts of native ecology and soils.
- No registered sites of Indigenous, maritime or European heritage are present within the Project area.
- Port Spencer has less sensitive marine, flora and fauna habitats than Point Gibbon which was identified as potentially having four threatened flora species and 19 threatened fauna species, including four marine fauna species. A total of 29 migratory species potentially using Point Gibbon were also identified in a Protected Matters Report review under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Port Spencer has potential for future rail access and upgrade from Ungarra (27 km to the north west), which would connect the Port to the Eyre Peninsula narrow gauge network. Centrex does not require rail for mine development in the short or long term. The site layout has considered rail in layout design in line with good engineering practice and providing flexible infrastructure options for possible future users.
- Both locations afford reasonable access to potential Centrex iron ore resources; Port Spencer is 125 km from Centrex's Wilgerup mine and Point Gibbon is 100 km away.
- The land at Port Spencer was available to purchase on the gulf front, with enough acreage to support several mineral exporters and the grain industry once fully developed.

Extensive community consultation has been undertaken for the Project (refer Section 1.4) at Centrex's preferred site. During community information days, held in April 2011, some members of the community suggested Cape Hardy, approximately 7 km to the north, as a potential port site. By this time, Centrex's feasibility studies had already identified Port Spencer as a viable location. Generally, community stakeholders and local government representatives have been supportive of the site selection and of the potential economic and social benefits which could come from its development. For more information about stakeholder responses refer Section 1.4.

2.7 Project Need, Benefits and Alternatives Summary

Existing ports and alternative routes to market were considered as part of the early planning and feasibility studies for this Project. Seven alternative ports were considered including Port Lincoln, Whyalla and the proposed Port Bonython. Based on this assessment the existing ports are not considered suitable to meet Centrex’s mining and shipping needs, refer summary Table 2-6.

Table 2-6: Assessment Summary of Existing Port Options within South Australia

Criteria	Whyalla	Port Bonython (proposed new port)	Proper Bay, Port Lincoln	Boston Bay, Port Lincoln Brennans Jetty	Thevenard	Port Pirie	Port Adelaide
Cape class Vessel capability	●	●	●	●	●	●	●
Proximity to iron ore resources and targets	N/A	●	●	●	●	●	●
Potential environmental impact	N/A	●	●	●	●	●	●
Economic impact	N/A	●	●	●	●	●	●
Terminus congestion	N/A	●	●	●	●	●	●
Likely community support	N/A	●	●	●	●	●	●

Legend: ● Unlikely to be suitable ● potentially suitable ● Suitable
 N/A Not assessed, since access not available.

Based on consideration of the following, it is considered the Project is a suitable location for a private multi-user Cape class vessel capable port:

- Existing port options in SA
- Centrex’s commercial and schedule needs
- Site selection assessments, and
- The alignment of Port Spencer with environmental, economic and social local, regional and State development goals and opportunities.

Without the Project, Centrex and developers of other mineral deposits may face increased transport and economic costs and limited transport export options that could negatively impact the viability of mine development. Centrex has secured land at the Port and is well advanced in discussions with utility providers, other potential Port users and local government.

The Project is proposed to be undertaken in stages to reflect expected Centrex mining export requirements over time. This staged approach allows a more balanced investment with regard to capital expenditure and would facilitate Port development in the shorter rather than long term. Rather than waiting for all mine projects to develop at the same time, the Port can be developed to meet Wilgerup and other party needs. Port design has included flexibility by considering potential future transport and other facility expansion options.

In addition the Port's development would facilitate a number of benefits at local, regional and State level. Table 2-7 provides a summary of key environment, economic and social benefits offered by development of the Port and its current location.

Table 2-7: Project Benefit Summary

Environmental Benefits	Section reference	Economic Benefits	Section reference	Social Benefits	Section reference
<ul style="list-style-type: none"> Reduce long road haulage of product and minimise the carbon footprint of potential port users. 	Section 6.1	<ul style="list-style-type: none"> Provide a ready market to overseas customers wanting to buy iron ore from Eyre Peninsula. 	Section 2	<ul style="list-style-type: none"> Communities have been consulted and will have further opportunity for comment on PER. 	Section 1.4
<ul style="list-style-type: none"> Provide access to Cape class vessels, increasing the capacity of each export load and minimising the carbon footprint of potential port users. 	Section 2	<ul style="list-style-type: none"> Stimulate industry growth and diversify regional economic base. 	Section 2	<ul style="list-style-type: none"> Located away from populated areas, to minimise operational disturbance. 	Section 5.2
<ul style="list-style-type: none"> Deep water access within 515 m of shore removing the requirement for marine dredging. 	Section 4	<ul style="list-style-type: none"> Provide \$AUD250 million of private investment into the Eyre Peninsula region and South Australia. 	Section 2	<ul style="list-style-type: none"> Provide employment and training opportunities to local and regional residents. 	Section 6.15
<ul style="list-style-type: none"> Location provides existing access to transport routes, including potential for future rail access⁷. 	Section 5	<ul style="list-style-type: none"> Create local, regional and state employment opportunities. 	Section 6.15	<ul style="list-style-type: none"> Provide contracting opportunities to local and regional businesses. 	Section 6.15
<ul style="list-style-type: none"> Project site is in a very degraded condition. 	Section 5.9	<ul style="list-style-type: none"> Stimulate direct and indirect business growth for local and regional companies. 	Section 6.15	<ul style="list-style-type: none"> Potentially attract new employees and their families to permanently relocate. 	Section 6.15
<ul style="list-style-type: none"> Project site presents fewer potential impacts to land and marine flora and fauna, compared to other sites. 	Sections 2.6, 6.11 and 6.9	<ul style="list-style-type: none"> Reduced jetty construction costs due to proximity of deep water to coast line. 	Section 2	<ul style="list-style-type: none"> Potentially impacted communities will benefit from associated road and power upgrades. 	Section 6.15
Intentionally blank	-	<ul style="list-style-type: none"> Diversification of regional economic base. 	Section 6.15	<ul style="list-style-type: none"> No registered sites of Indigenous, maritime or European heritage are present within the Project area. 	Section 5.13

⁷ Centrex does not require rail for mine development in the short or long term. The site layout has considered rail as part of layout design in line with good engineering practice and providing flexible infrastructure options for possible future users.

3.0 PLANNING AND ENVIRONMENTAL LEGISLATION AND POLICIES

This section describes applicable South Australian and Commonwealth legislation and outlines how the Project meets their requirements. It also considers State and Local Government planning strategies and policies.

3.1 South Australian Legislation

3.1.1 Development Act 1993

The *Development Act 1993* and associated regulations provide for the:

- Planning and regulation of developments
- Use and management of land and buildings
- Design and construction of buildings, and
- Maintenance and conservation of land and buildings.

On 6 January 2011 the (then) Minister for Urban Development, Planning and the City of Adelaide declared this project to be a 'Major Development' under section 46 of the *Development Act 1993*. Projects declared to have 'Major Development' status are considered to be of major environmental, social or economical importance to South Australia. The DAC determined the project to require a Public Environmental Report (PER) and provided the Project *Guidelines for the preparation of a Public Environmental Report, Sheep Hill Deep Water Port Facility (Stage 1) on Eyre Peninsula* (the 'Guidelines').

This PER document has been written to address the Guidelines and is the principal document used to seek development approval. The Minister will refer the PER to relevant government authorities and bodies, as well as the District Council of Tumby Bay, for their review. The PER and all supporting documentation will also undergo a period of public exhibition, during which the Minister will hold a public meeting to provide information on the Project and explain the PER process.

Once the public exhibition period is complete, the Minister will provide Centrex with copies of all matters raised by government authorities or bodies and submissions received during the public exhibition period. Within two months of receiving the submissions, Centrex will provide a Response Document to the Minister for consideration along with this PER. The Minister will then prepare an Assessment Report for the Governor to consider when assessing the project. Based on the PER, Response Document and Assessment Report, the Governor will either approve the project, subject to conditions, or refuse the project.

3.1.2 Environment Protection Act 1993

The *Environment Protection Act 1993* and associated regulations provide for the protection of the environment and are administered by the Environment Protection Authority (EPA). The Act also provides for the establishment of environment protection policies and guidelines.

While Major Developments assessed under the *Development Act 1993* are exempt from having to apply for works approvals under this Act, the EPA is provided the opportunity to assess prescribed activities of environmental significance listed under Schedule 1 of the *Environment Protection Act 1993*. Relevant EPA licences will still need to be gained if the Project is approved. The Minister will include the EPA assessment of prescribed activities of environmental significance in the Assessment Report to the Governor. In this Project, prescribed activities are likely to include the following activities found in Schedule 1, Part A of the *Environment Protection Act 1993*:

- *S 1(5) Petroleum Production, Storage or Processing Works or Facilities: The conduct of works or facilities at which petroleum products are stored in tanks with a total storage capacity exceeding 2,000 cubic metres.*

The Project would store petroleum products in storage tanks exceeding a total storage capacity above 2,000 m³. Procedural management measures would be implemented to minimise the risks present with storage and transfer of such substances.

- *S 7(1) Bulk Shipping Facilities: The conduct of facilities for bulk handling of agricultural crop products, rock, ores, minerals, petroleum products or chemicals to or from any wharf or wharf side facility (including sea-port grain terminals), being facilities handling or capable of handling these materials into or from vessels at a rate exceeding 100 tonnes per day.*

The Project would be capable of bulk handling and loading vessels with iron ore and crop products at a rate exceeding 100 tonnes per day. Environmental management measures would be implemented to minimise the impact to the terrestrial and marine environment from this activity.

- *S 7(4) Dredging: Removing solid matter from the bed of any marine waters or inland waters by any digging or suction apparatus, but excluding works carried out for the establishment of a visual aid to navigation and any lawful fishing or recreational activity.*

It should be noted that dredging is not required as part of Port operational activities (i.e., to allow safe passage of vessels or to create a berth pocket for vessels), due to the location of the jetty within deep water, that is approximately 20 m at estimated low astronomical tide. The jetty structure is proposed to be located within the marine environment, which will require disturbance of the seabed to allow for construction of the jetty structure. Environmental management measures would be implemented to minimise the impact to the marine environment from this activity.

Other relevant policies under the *Environment Protection Act 1993* include:

- *Environment Protection (Air Quality) Policy 1994*
- *Environment Protection (Burning) Policy 1994*
- *Environment Protection (Motor Vehicle Fuel Quality) Policy 2002*
- *Environment Protection (National Pollutant Inventory) Policy 2008*
- *Environment Protection (Noise) Policy 2007*
- *Environment Protection (Waste to Resources) Policy 2010, and*
- *Environment Protection (Water Quality) Policy 2003.*

3.1.3 Other State Legislation

There are a number of other legislative delegations approvals, permits and licenses that would be required prior to the construction and operation of the Project . A summary of relevant Acts is provided in the following sections.

Aboriginal Heritage Act 1998

The *Aboriginal Heritage Act 1988* provides protection for Aboriginal objects, remains and sites of spiritual, archaeological, anthropological and historical significance. This Act contains provisions for traditional owners to determine the significance of land or objects to Aboriginal people.

Discovery of any Aboriginal objects or sites are to be reported to the Minister for Aboriginal Affairs and Reconciliation as soon as practicable. If destruction, disturbance or interference with a registered site is required, an application must be submitted to the Minister under this Act.

Refer to Sections 5, 6 and 7 for further information.

Climate Change and Greenhouse Emissions Reduction Act 2007

The *Climate Change and Greenhouse Emissions Reduction Act 2007* provides measures to address climate change with a view to assisting the achievement of a sustainable future for the State. This is through the establishment of targets to achieve a reduction in greenhouse gas (GHG) emissions within the State, to promote the use of renewable sources of energy, to promote business and community understanding about issues surrounding climate change and to facilitate the early development of policies and programs to address climate change. This Act is not directly relevant to the Project however the PER considers Federal, State and Local Government development policies, strategies and guidelines that do consider climate change.

Refer to Section 7 for further information.

Coast Protection Act 1972

The *Coast Protection Act 1972* provides for the conservation and protection of the beaches and coast of South Australia and is administered by the Department of Environment and Natural Resources (DENR). It establishes the Coast Protection Board which serves the function of managing the beaches and coast through the development and implementation of management plans, provision of funds for protection works and undertaking certain works. The Coast Protection Board is a key referral agency in the development assessment process for proposals likely to affect the coastal environment.

The management of the coastline in the vicinity of the Project is described in Section 7.

Dangerous Substances Act 1979

The *Dangerous Substances Act 1979* regulates the keeping, handling, transporting, conveyance, use and disposal of dangerous substances. In the context of the Port this would mainly be the fuel and fuel oil stored and used at the port facility. Fuel products would not be loaded or unloaded from shipping vessels at the Port.

Harbors and Navigation Act 1993

The *Harbors and Navigation Act 1993* provides measures for the administration, development and management of harbors and provides for safe navigation in South Australian waters. The Act also addresses the establishment and control of state navigational aids, administers aquatic licences, marine vessel registration and maritime safety principles.

In December 2011 DPTI advised Centrex that the government is of the view that if approved, the Project should be defined as a port pursuant to the Act.

Heritage Places Act 1993

The *Heritage Places Act 1993* provides for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance and establishes the South Australian Heritage Council. It recognises the importance of South Australia's heritage places and related objects in understanding the course of the State's history, including its natural history. The Act also encourages the sustainable use and adaptation of heritage places in a manner consistent with high standards of conservation practice, the retention of their heritage significance, and relevant development policies.

Refer to Section 5 for further information.

Historic Shipwrecks Act 1993

The *Historic Shipwrecks Act 1993* relates to the protection of certain shipwrecks and relics of historic significance. Generally, the remains of ships and their relics that have been in territorial waters for a minimum of 75 years are considered historic. They are managed through the implementation of measures such as the maintenance of a register of historic shipwrecks, implementation of protection zones and through the prohibition of actions which may interfere or damage the wrecks or relics.

Refer to Section 5 for further information.

Marine Parks Act 2007

The *Marine Parks Act 2007* establishes a system for declaration and management of marine parks in South Australia. There are currently 19 declared multi-use marine parks along the South Australian coastline. The Project area and adjoining marine environment are not contained within a marine park.

The closest marine parks to the Project are the Sir Joseph Banks Group Marine Park, located approximately 22 km to the south and the Franklin Harbour Marine Park, located approximately 65 km north-east of the project.

National Parks and Wildlife Act 1972

The *National Parks and Wildlife Act 1972* provides for the establishment and management of reserves for public benefit and enjoyment and provides for the conservation of wildlife in a natural environment. Reserves and sanctuaries are managed through the implementation of management plans and the conservation of native plants and animals is achieved through provisions which regulate their taking, release and holding.

Refer to Section 7 for further information.

Native Title (South Australia) Act 1994

The *Native Title (South Australia) Act 1994* is complementary to that of the Commonwealth *Native Title Act 1993*. It recognises that some Indigenous people have rights and interests in their land that are based in their traditional laws and customs and establishes a framework whereby Indigenous Australians can lodge claims for recognition of native title. A South Australian register of native title claims is held and the assessment process for the assessment of claims is established. The Act also validates past acts of government which may extinguish or impact upon the existence of native title.

Native Vegetation Act 1991

The *Native Vegetation Act 1991* is administered by DENR and further by the Native Vegetation Council (NVC). This Act regulates the clearance of all native vegetation and provides incentives and assistance to landowners in relation to the preservation and enhancement of native vegetation. Operations authorised under Section 48 of the *Development Act 1993* are assessed in accordance with Native Vegetation Regulation 5(1)(c). Requirements of the regulation include that clearance is conducted in accordance with an approved Native Vegetation Management Plan and that the NVC is confident it will provide a Significant Environmental Benefit (SEB).

Refer to Sections 5, 6 and 7 for further information.

Natural Resources Management Act 2004

The *Natural Resources Management Act 2004* promotes sustainable and integrated management of the state's natural resources and provides for their protection. The Act includes provisions relating to the sustainable extraction of surface water and groundwater resources and allows for further protection of groundwater and surface water resources by prescribing those areas under the Act.

The Project area is not within a prescribed groundwater area and does not contain any prescribed watercourse, lake or surface water areas. Refer to Sections 5 and 6 for further information.

3.2 Commonwealth Legislation

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* applies to all Commonwealth territories and waters. Any proposed actions that are likely to have a significant impact upon defined matters of national environmental significance are subject to an assessment and approval process through the federal Minister for Sustainability, Environment, Water, Population and Communities.

Centrex considers the Project is unlikely to have an impact upon any defined matters of national environmental significance. Therefore a referral to the federal Minister for Sustainability, Environment, Water, Population and Communities has not been made.

3.2.2 National Greenhouse and Energy Reporting Act 2007

The *National Greenhouse and Energy Reporting Act 2007* provides for the reporting and dissemination of information related to GHG emissions, greenhouse gas projects, energy production and energy consumption. It establishes a single national reporting framework with the following objectives:

- To underpin the introduction of an emissions trading scheme in the future.
- To inform government policy formulation and the Australian public.
- To meet Australia's international reporting obligations.
- To assist Commonwealth, State and Territory government programs and activities.
- To avoid the duplication of similar reporting requirements in the States and Territories.

Refer to Sections 6 and 7 for further information in relation to greenhouse and energy reporting and impact assessment.

3.2.3 Native Title Act 1993

The *Native Title Act 1993* recognises that Indigenous people may have rights and interests in relation to land that is based on the existence of traditional laws and customs. The Act established the National Native Title Tribunal and provides a process through which Indigenous Australians can lodge claims for recognition and determination of native title and allows for each state and territory to implement its own native title legislation complementary to the Commonwealth Act.

Centrex owns the freehold land titles to the main Project site and therefore native title has been extinguished. Native title rights may exist in relation to the coastal zone and sea bed where the jetty would be constructed. Centrex is currently liaising with the Department of Planning, Transport and Infrastructure (formerly known as the Department of Transport, Energy and Infrastructure) and DENR to secure appropriate tenure to those areas.

3.2.4 Quarantine Act 1908

The *Quarantine Act 1908* protects the borders of Australia from natural hazards. Under s 4(1)(b), the scope relating to quarantine in Australia also relates to measures that prevent or control the ‘...introduction, establishment or spread of diseases or pests that will or could cause significant damage to human beings, animals, plants, other aspects of the environment or economic activities.’ This is relevant to the Project’s operations including the intake and discharge of ballast water.

Refer to Sections 6 and 7 for further information.

3.3 State Strategic Plans

This Section considers how the Project aligns with relevant State and Local Government strategies and policies. This section should be read with regard to the aforementioned Section ‘2.0 Project Need, Benefits and Alternatives’ to obtain a complete understanding of how the Project fits with both the requirements and the needs of the Eyre Peninsula Region.

3.3.1 South Australia’s Strategic Plan 2011

South Australia’s existing Strategic Plan (SASP) was updated in 2011 and provides a framework for the continued development of the State. The plan is based on six objectives, which are:

- *Growing prosperity*
- *Improving wellbeing*
- *Attaining sustainability*
- *Fostering creativity and innovation*
- *Building communities, and*
- *Expanding opportunity* (Government of South Australia, 2011).

The key objective relevant to this Project is that of ‘growing prosperity.’ The SASP recognises the importance of growth in South Australia’s export activities for growing prosperity. These six objectives are supported by 100 targets. Relevant targets to the Project include:

- *Target 37: Increase the value of South Australia’s export income to \$AUD25 billion by 2020.*
- *Target 41: Exploration expenditure in South Australia to be maintained in excess of \$AUD200 million per annum until 2015.*
- *Target 42: Increase the value of minerals production and processing to \$AUD10 billion by 2020), as key targets for growing prosperity* (Government of South Australia, 2011).

The Project will directly increase export activities and will indirectly support an increase in resource sector activities on the Eyre Peninsula through the provision of a gateway to export markets.

3.3.2 Strategic Infrastructure Plan for SA 2004/5 – 2014/15

The Strategic Infrastructure Plan for SA 2004/5 – 2014/15 considers the strategic infrastructure needs of South Australia until 2015 (Government of South Australia, 2005). The purpose of this plan is to guide new infrastructure investment by the government and private sector over the period of the plan and is based upon the targets identified in the SASP.

One of its objectives is to develop efficient, affordable and safe transport systems throughout South Australia that will contribute toward the achievement of targets such as trebling the value of South Australia's export income by 2013 and increased investment in strategic areas of infrastructure (such as ports) (Government of South Australia, 2005). The plan also recognises the potential for improved port facilities on the Eyre Peninsula. The development of this project would directly align with these strategic infrastructure objectives.

3.3.2.1 Regional Plan of the Eyre Peninsula

The *Regional Plan of the Eyre Peninsula* is included within the Strategic Infrastructure Plan for SA. A regionally specific quality of the Eyre Peninsula is the export orientated industries including; fishing, mining and agriculture. Bushfires in the recent past have destroyed significant parts of the Eyre Peninsula's infrastructure, both public and private. *'The State Government, in co-operation with Australian and local governments, is currently working on an extensive recovery program which includes infrastructure replacement.'* This regionally specific issue is supported by the proposed Port's development by providing enhanced regional export capabilities and locally upgraded infrastructure.

The Project is consistent with, and would assist with, achieving the economic and development objectives across a number of areas through the provision of new port infrastructure on the Eyre Peninsula. The Project would also assist with the continued development of the mining sector and other export industries in the region through the provision of a suitable private multi-user port facility on the Eyre Peninsula.

3.3.3 Living Coast Strategy for South Australia

The Living Coast Strategy for South Australia (DEH, 2004) sets out the State Government's environmental policy directions for sustainable management of South Australia's coastal, estuarine and marine environments. While it focuses on promoting environmental stewardship, it also supports development of industries operating within sustainable frameworks. It is submitted that this strategy is not prohibitive of such development but merely targets the need for sustainable management of South Australia's coastal, estuarine and marine environments.

3.3.4 Tackling Climate Change, SA's Greenhouse Strategy 2007–2020

South Australia's Greenhouse Strategy, Tackling Climate Change, is a framework that allows the State's GHG targets and commitments to be met in a comprehensive and coordinated way. The strategy takes three approaches to the future:

- Reducing greenhouse emissions
- Adapting to climate change, and
- Innovating in markets, technologies, institutions and the way we live.

It frames those approaches into objectives and strategies, each with a common set of challenges in adapting to climate change and common opportunities to reduce GHG emissions, although issues will and do overlap sectors, including industry.

In addition, Tackling Climate Change has sections dealing with two themes; leadership and adaptation. Each section contains a goal, a series of strategies, objectives and actions that outline the means to achieve the goal. Taken together these provide a coherent framework for the State as a whole to respond to climate change, and for different sectors to inform and guide their climate change policy and actions.

The strategy contains a Government Action Plan which is a framework to guide the activities of government agencies in meeting the Kyoto emissions reduction target in South Australia within the first commitment period of 2008–12. The action plan nominates priorities for action to 2012, but this does not represent a final commitment by government. Some of the proposals are currently unfunded and will require separate budgetary consideration.

The effectiveness and currency of Tackling Climate Change and progress with implementation will be monitored and its content reviewed and updated as necessary. Monitoring and reporting on progress will be an integral part of the reporting regimes for South Australia's Strategic Plan and South Australia's climate change legislation.

Centrex's commitment to an effective GHG strategy is provided in further detail in Sections 6 and 7 of the PER. The Project offers a significant benefit in reducing the potential GHG intensity of export transport options for industries on the Eyre Peninsula.

3.3.5 Eyre Peninsula Coastal Development Strategy

The Eyre Peninsula Coastal Development Strategy (EPCDS) outlines a vision for development of the Eyre Peninsula coast (EPLGA, 2007). The EPCDS seeks to provide a balanced approach to coastal development planning and considers land up to 500 m from the high-water mark or within an area identified as a coastal zone in local government Development Plans. The EPCDS provides some broad guidance to other areas abutting the coast where development may have a direct impact on the coast. It recognises that the coast provides a key export gateway to international markets, a role that is expected to grow in response to the expanding mining/resource sector. The nine guiding principles of the strategy are as follows:

- Ensuring ecologically sustainable development
- Protecting cultural and heritage values
- Enhancing economic development opportunities
- Recognising the interdependence between land and sea
- Integrating infrastructure and land use planning
- Protecting biodiversity and areas of biological significance
- Protecting coastal landscapes and wilderness values
- Facilitating appropriate public access to the coast, and
- Minimising the exposure of people and property to coastal hazards.

The EPCDS recognises the importance of export related infrastructure, such as port facilities, to support growth in the agricultural and mining sectors. For the continued prosperity of the Eyre Peninsula, the development of ports and export infrastructure is required to maximise the competitive advantage of local businesses and industries. The strategy also recognises that consideration of new port facilities require specific detailed studies, including environmental impact assessments. This PER document assesses the environmental impact of the Project and is consistent with the approach identified in the strategy.

3.4 Development Plans

3.4.1 Tumby Bay District Council Development Plan

Based on the provisions of the Tumby Bay District Council Development Plan (consolidated 13 January 2011) (the 'Development Plan') the Project and its associated infrastructure are located within two zones: coastal zone and general farming zone. The following sections outline the key provisions relevant to the Project, from the Development Plan.

Coastal Zone

The primary intent of the coastal zone is to protect the coast and associated native vegetation, and also seeks to protect primary production land from incompatible land use. The Development Plan also states that development should satisfy the following requirements, and comment on the Project's performance against these items is provided:

- Manage development in coastal areas to sustain or enhance the natural coastal environment.
 - The Project has a limited footprint of 48 ha required for Stage 1. Rehabilitation of existing degraded coastal native vegetation is proposed to enhance the coastal areas. Revegetation with suitable native vegetation species is also proposed, refer Sections 6 and 7.
 - The site was selected for the relatively short jetty length required to reach deep water: a jetty length of approximately 515 m from the shore with a 320 m berth jetty. Due to the remote location of the Project the site is only visible from a small number of residences, and has some visibility from the Lipson Island Conservation Park located 1.5 km from the jetty to the south and will be visible from Rogers Beach which is immediately adjacent the northern boundary of the site. Site infrastructure design and layout has been considered in conjunction with existing coastal hills as screening, as well as colouring to minimise contrast with the landscape. The expected visual impact of the Project is assessed in Section 6.
- Protect the coast from development that will adversely affect the marine and onshore coastal environment whether by pollution, erosion, damage or depletion of physical or biological resources, interference with natural coastal processes or any other means.
 - The site would be operated in such a way as to minimise the potential for negative impacts. The site does not include significant conservation species from either a terrestrial or marine ecology, heritage, or biodiversity perspective. The Port is not expected to negatively impact coastal processes at beaches outside the immediate jetty area. Project stormwater would be managed onsite and not be discharged to the marine environment.

The impact assessment of the Port on coastal processes and marine receptors is discussed in Section 6 and mitigation and risk assessment provided in Section 7.

- Not interfere with environmentally important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas.
 - There are no mangroves, wetlands or estuarine areas located within the Project area. The Project has degraded low habitat value native vegetation only and does not include fauna or habitat areas of significance. Rehabilitation of existing degraded coastal native vegetation is proposed to enhance the coastal areas. Rogers Beach is located adjacent the northern boundary of the Project and includes some beach and dune areas, however these are outside the Project footprint and are not expected to be impacted directly by operations, refer Section 5, 6 and 7.
- Not detract from or reduce the value of sites of ecological, economic, heritage, cultural, scientific, environmental or educational importance.
 - The Project is located in an area of low ecological, economic, heritage, cultural, scientific, environmental or educational importance, and does not contain significant registered conservation sites, species of significance, habitat areas or high economic value agricultural activities. Section 5 outlines the existing environment at the site.
- Preserve areas of high landscape and amenity value including stands of vegetation, exposed cliffs, headlands, islands and hill tops, and areas which form an attractive background to urban and tourist developments.
 - The Project layout is located in a remote location, inland from the coast line and takes into account existing terrain and elevations to assist with screening of expected infrastructure. The jetty and shipping vessels would be visible from the Lipson Island Conservation Park located 1.5 km south of the jetty. The visible impact is expected to be minimal from this area. The Park includes a small camping area, which would have limited views of the Port. There are not expected to be noise or air quality impacts from this location such that they would impact tourism amenity. Section 6 provides a discussion of expected socio-economic and visual aesthetic impacts.
- Maintain or enhance public access to coastal areas in keeping with objectives for protection of the environment, heritage and amenity.
 - The Project would maintain public access to Rogers Beach and the development would not impact existing access to Lipson Island Conservation Park. The sealing and upgrading of Lipson Cove Road, for the purposes of Project light vehicle access, may increase the accessibility of the area to the public.

Other provisions of note are as follows:

- Provision should be made for the treatment and disposal of septic tank effluent by an approved waste control system such that the septic tank effluent disposal system is at least 100 metres from the mean high water mark.
 - An onsite septic system would be constructed as part of Project development and will be at least 100 metres from the mean high water mark.

- No buildings within 50 m high water mark, or on cliff top, watercourses and wetland basin.
 - There are no wetlands or permanent watercourses in the Project area. No buildings would be constructed within 50 m high water mark, or on cliff top. It is noted conveyors would pass from onshore built assets along the coast line onto the jetty. The jetty would make contact with the shoreline as part of overall design. Access underneath the jetty would be maintained as part of Project design.
- Appearance of development (colours, materials, etc.) should be compatible with coastal and rural environment and should not obscure views of or from coast.
 - The layout of the Project infrastructure has considered visual impacts as part of layout and design. The project would also be screened by natural headland elevations south of the proposed infrastructure. Building design incorporates visual screening, including colour. Refer section 7.3.13.
- Buildings should be designed, sited and screened with suitable species to retain amenity and character of natural landscape.
 - The Project layout is located in a remote location, inland from the coast line and takes into account existing terrain and elevations to assist with screening of expected infrastructure. The jetty and shipping vessels would be visible from the Lipson Island Conservation Park located 1.5 km south of the jetty. The visible impact is expected to be minimal from this area. The Park includes a small informal camping area, which would have limited views of the Port. Native vegetation screening would be planted by Centrex along the southern boundary, Lipson Cove Road. Section 6 provides a discussion of expected visual aesthetic impacts, and mitigation is discussed in Section 7.
- Public access should be managed to protect environmentally sensitive seagrass and sand dune communities.
 - Visiting shipping vessel personnel would not be permitted to disembark while at berth. There are no sand dune communities located within the Project area. In line with federal quarantine and security requirements public access to the jetty surrounds would not be permitted. Marine impacts are discussed further in Section 6.

The Project would alter the natural environment of the coastal zone and has the potential to impact on the visual amenity of the area; however, the impact from the alteration would be managed in such a way as to protect and enhance coast and coastal features as far as possible. Native vegetation would be retained or replaced in an appropriate manner, as relevant, refer Section 7. Assessment of the potential visual impacts and the associated management and mitigation measures to be implemented by the project are outlined in Sections 6 and 7. Public access to adjoining beaches such as Rogers Beach and Lipson Cove would be maintained. Existing sand dunes at Rogers Beach are outside the Port development footprint.

General Farming Zone

The general farming zone seeks to promote agricultural activities on relatively large allotments. There is some recognition of the need to accommodate agro-based industry (including processing and handling), but the proliferation of these kinds of activities and other uses that threaten the functionality of agriculture are to be avoided. The plan identifies that future development of the zone should not result in the conversion of agricultural land into less productive uses.

Other provisions of note which are relevant to the Project include the following:

- The need to preserve features of scenic or environmental significance.
- Need to protect support infrastructure for bulk handling and transport of farm commodities located near Port Neill.
 - The Project would not impact this provision.
- Development of a commercial/industrial nature should not take place unless associated with agricultural processing or handling; does not cause traffic issues; does not prejudice use of land for agriculture; does not impair amenity; cannot be accommodated elsewhere.
 - Development of the Port as a multi-user facility would offer a significant farm commodity export alternative for Eyre Peninsula producers. Grain producers have expressed interest in the development and Stage 1 includes bulk grain storage and loading facilities, refer Section 4.
- Development should not occur within 300 m of land used for handling, storage and transportation of farm commodities in bulk. Development within 300 m should not prejudice their continued operation (including extended operation during harvest).
 - The Project would not impact this provision as current land use does not include handling, storage and transportation facilities for bulk farm commodities.
- Development that conflicts with facilities supporting handling, storage or transportation of farm commodities should not take place.
 - The Project would not impact this provision. Development of the Port has the potential to offer significant farm commodity export point for Eyre Peninsula producers, including grain.
- Roadside vegetation should be preserved.
 - Access to the Project site via Swaffers Road may require some road widening and potential for removal of native vegetation. This area was surveyed and significant native vegetation was not identified. Existing vegetation is discussed in Section 5 and project impacts are further discussed in Section 6. The approach to rehabilitation and revegetation is provided in Section 7.

The majority of the project is to be included in the general farming zone. Native vegetation would be retained where possible and native species planted in new landscaped areas, refer Section 7. The Project would also provide facilities for grain export, supporting other agricultural development. The Project area is relatively small and is not expected to cause significant loss of agricultural production potential.

Council-Wide Provisions

There are a number of Council-wide development provisions concerning coastal development (Development Plan objectives 53 to 68). Objective 60 makes specific reference to development being designed and located to allow for changes in sea level and climate change for the first 100 years of development. Assessment of the potential impacts associated with coastal processes and the management and mitigation measures to be implemented by the project are outlined in Section 6. The jetty and Port has included consideration of potential sea level rise in design.

There are also rural development provisions (Development Plan objectives 70 to 72) that seek to protect and maintain rural areas for agricultural uses while preserving the natural character and beauty of these areas. Assessment of the potential impacts to ecology and visual impacts and the management and mitigation measures to be implemented are outlined in Section 6 and 7. The agricultural uses of the surrounding area would not be adversely affected by the Project.

3.4.2 Other Development Plan

The Project is also subject to the Land Not Within a Council Area (Coastal Waters) Development Plan (consolidated 31 March 2011). This applies to amongst other items, the high water mark along the whole of the South Australian coast and the line three nautical miles seaward of low water mark, and includes both the Spencer Gulf and Gulf St Vincent. In the context of Port Spencer Stage 1, this Plan applies to the jetty and associated infrastructure that extend from the coastline. It does not apply to onshore infrastructure.

There are 39 objectives in the plan, which reflect consideration of a range of factors including economic development; public access; environmental, heritage, educational, scientific, cultural, economic and visual impacts; conservation and preservation. Objectives 35-39 apply to non-related development types. The development reflects the principles of development control as outlined in this Plan and included consideration of visual amenity, environmental and heritage values. Sections 5, 6 and 7 reflect the elements of the objectives and development controls and redress the areas of consideration.

4.0 PROJECT DESCRIPTION

This Section provides an outline of the proposed Project Stage 1 hematite, grain and Port infrastructure and locations. Hematite and grain storage and loading facilities have been designed using industry leading practice to minimise potential environmental and social impacts. The site layout has been designed to maximise operational efficiency, maintain separation between heavy vehicles, light vehicles and site workers and minimise potential visual impacts. Project construction is currently anticipated to commence in Q3 2012 and jetty construction is anticipated to take up to 24 months. Project operation would be within two years of commencement of construction.

Stage 2 of Project development will be subject to a separate Major Development application and would likely include: magnetite storage, magnetite dewatering and a desalination plant. Stages 3 and 4 of the Project would include expansion of the hematite and grain storage, additional magnetite storage sheds and dewatering and expansion of the desalination plant. These stages would be subject to separate application(s), (refer Section 1.2).

4.1 Nature and Location of the Project

The Port Spencer Stage 1 development would provide for hematite ore and grain export capacity. Approximately 48 ha of land would be required for Stage 1 Project development and the total site footprint is 140 ha. A three dimensional electronic animation of the proposed Stage 1 infrastructure (as described below) is provided within Appendix A. Stage 1 site infrastructure is proposed to include the following key features and is presented in Figure 4-1:

- Hematite:
 - Hematite storage shed, with a storage capacity of up to 240,000 t; approximate dimensions 250 m long x 70 m wide x 30 m high
 - Hematite in-loading shed; approximate dimensions 20 m long x 10.5 m wide x 7 m high, and
 - Hematite site office; approximate dimensions 12 m long x 4 m wide x 4 m high.
- Hematite site warehouse for equipment storage; approximate dimensions, 10 m long x 10 m wide x 8 m high.
- Grain:
 - A number of grain storage options are being considered at this time and would be finalised during detailed design phase:
 - Grain storage shed, with a storage capacity of approximately 60,000 t: approximate dimensions 182 m long x 48 m wide x 30 m high, or
 - Three 20,000 t grain storage silos with a maximum height of 30 m, or a bunker style grain storage area with a capacity of approximately 60,000 t.
 - Grain in-loading shed; approximate dimensions 20 m long x 10 m wide x 11.5 m high
 - Grain site office; approximate dimensions 12 m long x 4 m wide x 4 m high, and
 - Grain site warehouse for equipment storage; approximate dimensions 10 m long x 10 m wide x 8 m high

- Warehouse/storage shed for equipment storage; approximate dimensions 40 m long x 40 m wide x 10 m high including 40 m x 10 m mezzanine
- Single storey administration/office building, suitable for occupation by 20-30 personnel
- Single storey amenities building; approximate dimensions 8 m long x 4 m wide, single storey
- Enclosed conveyor galleries for proposed ore and grain in-loading and out-loading conveyor; approximate dimensions 4 m wide x 3 m high for the length of each conveyor
- Sampling station and enclosure for automatic sampling of iron ore and grain for quality assurance; approximate dimensions 10 m long x 10 m wide x 10 m high
- A truck weighbridge station, located at the haul road entrance point on Swaffers Road at the northern side of the site
- Electrical switch room; approximate dimensions 12 m long x 5 m wide x 4 m high
- Heavy fuel oil storage tank; approximate capacity 68,000 L
- Bulk diesel fuel tank; approximate capacity 10,000 L
- Jetty as presented in Figure 4-1 (refer Section 4.2):
 - The jetty would extend from the shoreline into the marine environment 515 m to a lowest astronomical tide water depth of approximately 20 m, and
 - Dredging is not required as part of Port operational activities due to location of the jetty within deep water.
- The jetty would contain built infrastructure including:
 - Industrial ship loader located on the berth stand suitable for loading ore and grain material into Cape class and Panamax sized vessels: approximate loading capacity of 5,000 t/h for iron ore and 1,400 t/h for grain.
- Haul road transport and infrastructure access corridor, which is 5 km in length from the Lincoln Highway and generally follows the alignment of the ungazetted Swaffers Road.
- Light vehicle access is proposed from Lipson Cove Road to the south of the site.
- Site car parking
- Stormwater retention and drainage facilities
- Fire service tanks and pump systems:
 - Fire fighting equipment would comprise a fire pump set, water storage tanks, distribution pipework and fire hydrants. Protection for critical jetty infrastructure would be provided by fire hydrants and hose reels.
 - Emergency procedures for fire response would be developed and implemented by the Port operator, and
 - Measures including provision of designated smoking areas on-site, internal site fire breaks and the use of roads and surface water drains would assist in minimising the escape of an on-site fire and the intrusion of off-site fires.

616,000

617,000



PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

PROJECT LAYOUT



LEGEND

- Site Fence
- Future Rail Line and Indicated Extent of Rail Batters
- Project Boundary
- Diversion Channel
- Existing Overland Flow Paths
- Drainage Corridor
- Culvert Drain
- Headwall
- Coastline

RL Reduced Level (m AHD)

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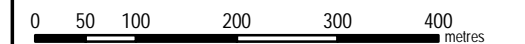


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Aerial image sourced from Bing Maps, date sourced 28.11.2011.

Plan sourced from Parsons Brinckerhoff, Drawing No: 217261A - GEN - 0003 Rev E, Drawn By: ASB, Drawn Date: 14.09.2011.

Township data sourced from MapInfo StreetPro.



SCALE (AT A3) 1:7,500
DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
DATE: 21 DEC 2011
DRAWN: KB / KRM
CHECKED: JAB

FIGURE 4-1



616,000

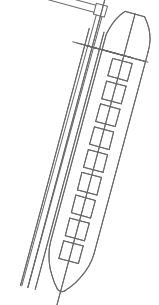
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4.1.1 Location

The Project is located on the east coast of Eyre Peninsula, approximately 210 km north-west of Adelaide, 70 km north-east of Port Lincoln, 21 km north-east of Tumby Bay and 20 km south-west of Port Neill (the closest residential area). The heavy vehicle traffic route would be accessed via Swaffers Road from the Lincoln Highway, approximately 5 km west from the Port. The unsealed Lipson Cove Road is located south of the site and travels from Lincoln Highway to the Lipson Island Conservation Park. The closest access point to the Eyre Peninsula's narrow gauge rail network is at Ungarra, located approximately 27 km north west from the Project.

The Lipson Island Conservation Park is located approximately 1 km south of the closest Project boundary, and approximately 1.5 km from the jetty. The Sir Joseph Banks Group Marine Park is located approximately 22 km south of the Project and the Port would be located within the Port Neill Aquaculture exclusion area.

4.2 Jetty Facilities

The preliminary Stage 1 Project design includes a jetty extending 515 m from the shoreline into the Spencer Gulf, to approximately 20 m deep water at lowest astronomical tide (LAT). This depth of water will accommodate up to 200,000 t Cape class size vessels at low tide with no draft restriction. This would allow Centrex to maximise jetty utilisation and remove the requirement for seabed dredging, which is a significant environmental impact at other ports. The vessel berth structure would be orientated up to 90 degrees to the jetty at an estimated length of 320 m to accommodate the full length of a Cape class vessel. The proposed jetty would be equipped with a ship loader capable of a loading speed of an average 5,000 t/h. The ship loader would be positioned on rails to allow mobility and it would travel (automatic or manual) along the jetty during ship loading activities. The ship loading capacity would be 5,000 t/h for iron ore and 1,400 t/h for grain.

A 1.5 m wide iron ore conveyor with fully enclosed galleries and a conveyor speed of 4.0 m/s for iron ore would be used for ship loading. The conveyor would be installed between the storage shed/s and ship loader and located along the southern side of the jetty. Vehicle access would be available along the northern side of the jetty onto the berth stand for servicing, repairs and maintenance of Port infrastructure.

Should grain be required for export from the jetty, a second independent conveyor would be installed above or beside the iron ore conveyor to a separate ship loader. The grain conveyor speed would be 4.0 m/s. An option of a single ship loader with two booms capable of delivering ore and grain is also under consideration, however this would be decided at a future date during detailed design.

Both conveyors are called "main" or "trunk" conveyors and would extend inland onto the Project site from the jetty approximately 1 km. All other/future exporters intending to use Port Spencer would be responsible for constructing their own storage facilities and connecting their load-out conveyors from the storage sheds to the trunk conveyor.

4.2.1 Shipping Lanes and Anchoring

The seawater depth at the jetty is approximately 8 m at the coast and drops to 20 m approximately 500 m off-shore and then continues to slowly increase in depth to 27 m. There is no current recommended shipping lane for vessels from the Project at this time, however a suitable path to the main shipping lane currently used by Cape class size vessels to access Onesteel Whyalla operations has been identified. Port related navigation aids and emergency response plans would be reviewed and established prior to operations. A hydrographic study of the seabed would be undertaken prior to operations to ensure suitable obstruction free shipping lane and determine seabed bottom suitability for Cape class vessel anchors.

The number of vessels expected at the jetty during early Project stages would be approximately 12 Cape class or 27 Panamax vessels per year for ore and 8 Panamax vessels for grain (i.e. a vessel every 18 days); 2 million tonnes of hematite and 0.5 million tonnes of grain would be exported. In rough conditions, with wind speed exceeding 40 knots or current speed exceeding 3 knots, ships would be moved from the berth and anchored approximately 4 km offshore in a minimum of 24 m depth of water.

4.3 Port Operation

A suitably experienced and qualified port management and operating company would be appointed to manage daily operations and management of the Port storage and ship loading facilities, including harbour master duties, safety and security, environment and emergency response. A port operator has not been appointed at this time. The Port would operate 24 hours 7 days a week. Site offices and car parking would be provided, but no on-site accommodation is proposed.

The Port Spencer operations would have a full suite of Operating, Safety and Emergency response plans and procedures for the land and marine environment to cover all potential incidents. These would be developed by the appointed Port operator.

Commodity (hematite and grain) access to the Project would be via a dedicated road train access corridor (Swaffers Road) to the north of the site. Light vehicles (up to AUSTRROADS class 2) would access the Project via Lipson Cove Road, adjoining the southern boundary of the site.

Site security would comply with all state and federal requirements, including fencing of the entire Project with security pass access only permitted past the site offices. Access to and from the jetty would be via secure access gates. Full Maritime Security Identification Card (MSIC) security procedures would be implemented on the site with Australian Quarantine and Inspection Services (AQIS) available for all vessel arrivals and export requirements, anticipated to be serviced from Port Lincoln. Vehicle access to the Port site would be via electronically operated security gates to prevent unauthorised entry.

4.4 Product Delivery

Stage 1 bulk dry hematite and grain would be delivered to the Project in sealed or covered B-double or road trains via Swaffers Road subsequent to upgrading and sealing of this road. All products would pass over a weighbridge upon arrival at the Port before commencing unloading.

Products would be unloaded in dedicated out-load hoppers fitted with dust extraction units. Unloading operations would also be undertaken inside ventilated enclosures to prevent dust escaping to the atmosphere in accordance with industry leading practice. Dry products would be transferred to storage sheds via sealed conveyors. The hematite storage shed would be fully enclosed, fitted with a dust collector and reverse air fabric filters and be equipped with a negative pressure dust extraction system to prevent dust escaping to the atmosphere.

Dry product would be conveyed to the ship loader in enclosed conveyor galleries fitted with dust collectors and pulsed jet fabric filters on all transfer points to minimise dust escape to the atmosphere. During ship loading, dust generation would be controlled by utilising fully enclosed boom conveyors and a chute into the hold of the ship. Water spray facilities would be available if required. Future detailed design of infrastructure and materials handling pathways will consider these dust management measures as part of final design.

4.5 Fuel and Chemical Storage

The Port would require use of the following types of general chemicals and chemical products:

- Hydrocarbon-based fuels, oil and grease
- Hydraulic fluid, brake fluid and coolant for plant and equipment
- Paint, detergents and disinfectants for hygiene purposes for offices, and
- Potentially fumigants for treatment of stored grain.

Generally chemicals would be stored in containers less than 200 L in volume inside relevant warehouse/storage sheds with appropriate bunding. Bulk storage for diesel generator (refer Section 4.7) fuel oil would be stored in a roofed above ground 68,000 L bunded tank. Bulk storage of fuels for plant and equipment will only be stored in a roofed above ground 10,000 L bunded tank. The bulk storage tanks would be designed in accordance with AS1940:2004 *The storage and handling of flammable and combustible liquids* and management and emergency procedures would be developed and implemented by the Port operator for the storage and use of fuel and chemicals.

4.6 Water Supply and Stormwater Management

Stage 1 Project water demand profile is estimated as follows:

- Approximately 1 ML/day for 10 months during the initial construction period for earthworks
- Approximately 0.25 ML/day for the following 15 months for construction of the jetty and site infrastructure, and
- Approximately 0.25 ML/day during Port operation.

Centrex has undertaken preliminary discussions with SA Water in respect to the provision of a water service to the Port for construction and potable water for Stage 1 operations only. SA Water has confirmed, water volume capacity is available without negatively impacting domestic security of supply. A new water supply pipeline would be constructed along Swaffers Road to the site and would connect with an existing main along the Lincoln Highway.

Future water demands for magnetite export would be supplied by a desalination plant proposed as part of Stage 2 Port development.

Non-potable water would be used for wash-down of plant and equipment, fire suppression systems and dust suppression. Non-potable water used onsite would be collected via the onsite drainage network and collection system. All storage facilities and buildings would be equipped with guttering and downpipes for the collection and harvesting of rain water. Figure 4-2 identifies conceptual stormwater management infrastructure, including the use of culverts, channel drop structures, an energy dissipation basin, and on-site stormwater retention pond. A 135 ML onsite extended detention pond would manage surface water allowing for a 1:100 year ARI peak flow rain event and zero discharge off-site. This stormwater would further provide volume for onsite water usage (refer Section 6).

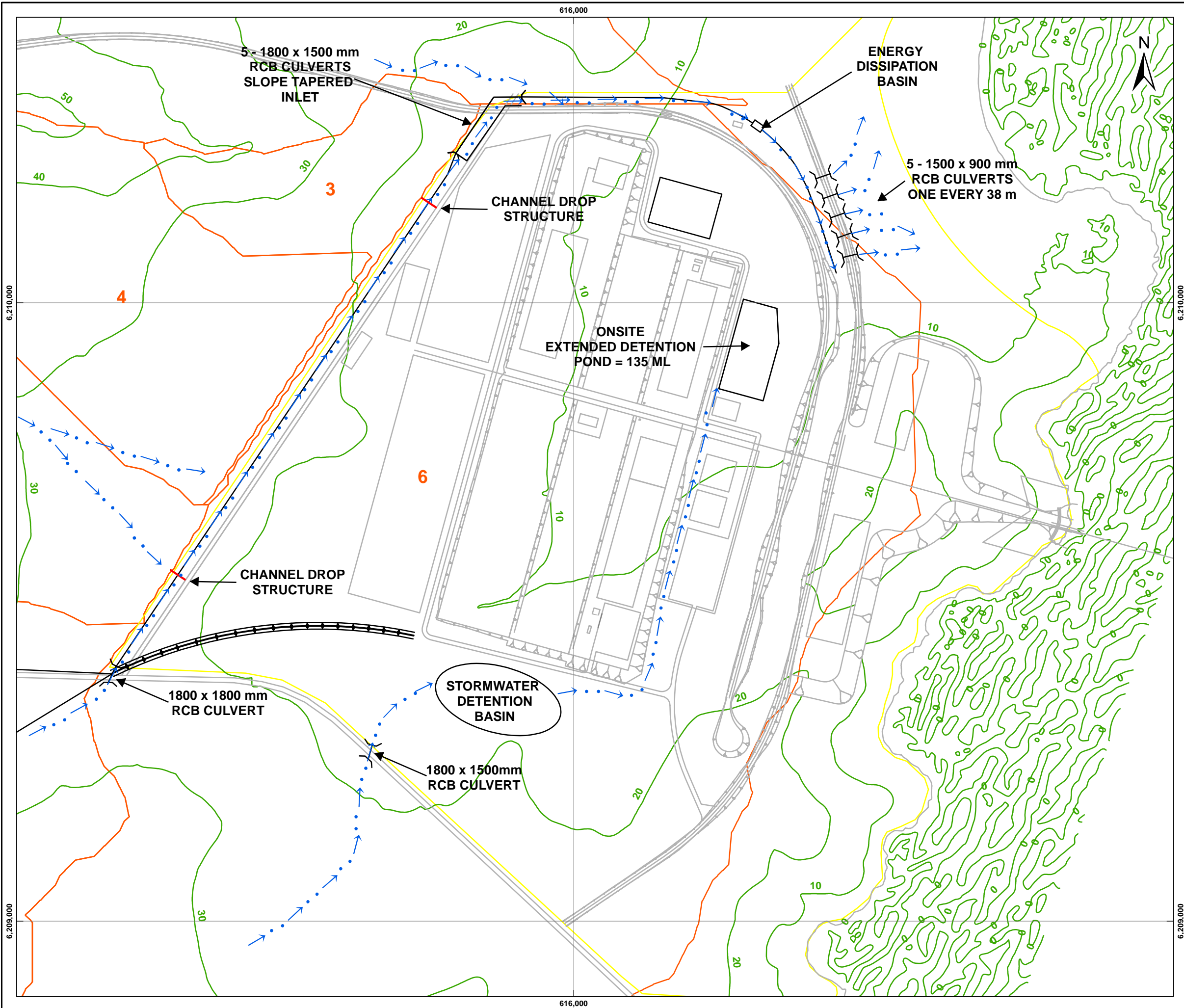
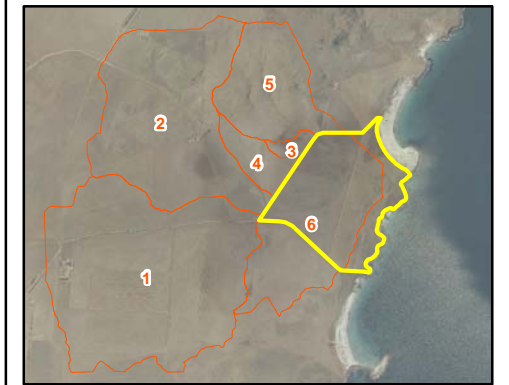
4.7 Power Supply

Stage 1 Project electricity requirements are not expected to exceed 5 MW. It is acknowledged the electricity supply network on the Eyre Peninsula is in need of upgrading to service the rapidly expanding minerals industry requirements. Several companies are investigating this issue currently. Centrex would contribute the major capital costs required for the expansion power utilities, for a spur line from the grid to the Site, but not for the upgrade of the main 132kv Eyre Peninsula transmission line. The development of this Project and associated mines has the potential to bring forward the scheduled upgrade of the regional main transmission line by several years, which offer significant regional benefits.

The Eyre Peninsula is recognised as one of the most suitable locations in Australia for wind generated power. Should the “green grid” upgrade, as proposed by ElectraNet, based on a new transmission line and significantly increased wind generated power capacity gain approval, Centrex would become a major user of this network. With Centrex’s mining and Port activities, including Stage 2, the desalination plant, future plant and equipment installation, Centrex would potentially consume in the order of 80 MW of power within five years, increasing to 200-250 MW within seven years.

Due to the time required for upgrade of powerlines, it is envisaged that power supply would be obtained initially via an on-site diesel generator during construction and then through connection to the existing electricity grid. The generator will not be required once the electricity transmission spur line is installed. The Project would continue to investigate opportunities for energy efficiencies and the potential for the use of alternative renewable sources of energy over Project life. Centrex will consider, as part of potential energy efficiency measures, the potential for installation of solar panels for site administration buildings.

CONCEPTUAL
STORMWATER DESIGN
GENERAL ARRANGEMENT



LEGEND

- Proposed Catchment Boundary and Label
- Project Boundary
- Contours (m AHD)
- Drainage Pattern
- Project Layout
- Culvert
- Overland Flow Diversion Bund

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Lidar contour data sourced from Centrex Metals Ltd, February 2011.
Base plan sourced from Parsons Brinckerhoff Drawing No: 2172612A-CIV-0003 Rev C. Drawn By: JMc Drawn Date: 15.08.2011.

Aerial image sourced from Department for Environment and Heritage South Australian Government 2007.

0 20 40 80 120 160 200 metres

SCALE (AT A3) 1:6,000
DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
DATE: 01 FEB 2012
DRAWN: KB / KRM
CHECKED: AMB

FIGURE 4-2



4.8 Road Access

This PER applies to road access from Lincoln Highway to the Port along Swaffers Road only. As part of separate Wilgerup mine approval works, two road transport routes are currently being investigated to provide a dedicated and direct road haulage route from the Wilgerup mine to the Port. It is expected that any other Port users would be responsible for identifying suitable transport options and complying with all State regulatory requirements.

The proposed Port road transport access corridor would generally follow the existing alignment of Swaffers Road from the intersection with the Lincoln Highway and be approximately 5 km long and 0.1 km wide. Light vehicles (up to AUSTRROADS class 2) would access the Project from the south via Lipson Cove Road which is under the care and control of the District Council of Tumby Bay. Centrex would be responsible for upgrading this road.

4.9 Construction Village

Centrex is considering development of a construction accommodation village ('village') on the outskirts of Tumby Bay. This village would house the Project construction workforce with an expected peak size of 200 personnel. It is also anticipated this village would be expanded to accommodate the construction workforce required for the development of the Eyre Iron Joint Venture (of which Centrex holds 40%) mine projects, should an economic operation be defined. This would expand the village to a peak size of approximately 1,000 workers.

A large percentage of the workforce would be expected to be fly in/fly out during the construction phase. Part of the village may be retained in the long term for operations fly in/fly out staff, however Centrex would also look at options to encourage employees to relocate permanently to Eyre Peninsula.

The construction village would be composed of single bedroom type units with self contained ensuite facilities in each unit. The units would be laid out to include covered areas between groups of units. Materials used for construction of the units would be chosen to ensure the village fits with the local surroundings as much as practical. The village would include its own recreational facilities, wet mess, kitchen and cook and internet facilities. This proposed design is still under review at this time.

Centrex is currently in preliminary discussions with Tumby Bay Council and a potential council-owned site for the construction village has been identified close to Tumby Bay airport, approximately 2 km from the town centre. This location is close to existing power and water mains. The recently sealed airstrip offers potential to fly in/fly out construction workers. Tumby Bay Council has recently upgraded the town effluent treatment plant and this now has sufficient capacity to accommodate the proposed construction village resident numbers. The majority of the construction workforce would be bussed to and from the Project site.

The development of this construction village will be subject to its own development application and associated social and environmental assessment. The construction village is not considered as part of this Port Spencer Stage 1 PER.

5.0 EXISTING ENVIRONMENT

Detailed Project environmental technical studies are presented in Appendices C to O. The following Sections provide a summary of the existing social and natural environment at the Project area.

5.1 Climate

5.1.1 Climatic Conditions

Climate has an influence on environmental impacts such as dust, noise and surface water management. Climate data from North Shields (Port Lincoln Automatic Weather Station (AWS)) (approximately 70 km south-west from Port Spencer) was reviewed, as no climate data is available from the Bureau of Meteorology (BOM) for Tumby Bay.

Based on BOM (2011) climate data for North Shields, the climate is temperate, characterised by hot dry summers and cool moist winters. Mean monthly temperatures range from a maximum of 25.9°C in January to a minimum of 7.1°C in August (Figures 5-1 and 5-2). Rainfall is approximately 385 mm per annum. Historically, the major rainfall period is during winter months (Figure 5-3).

The meteorology of the area is complex, with sea breezes, land breezes, and high ground to the west all interacting with regional scale winds. Local wind climate largely determines the pattern of off-site or site-specific pollutant dispersion. Wind patterns have been taken from Port Lincoln due to the similar coastal location.

Wind direction in the spring and summer months (October to March) is predominantly from the south-east. Although winds are observed from all directions in autumn and winter (April to September), they predominantly come from the north-west through to the west. High winds (> 5 m/s) are more common in summer, and light winds (< 2 m/s) more common in autumn.

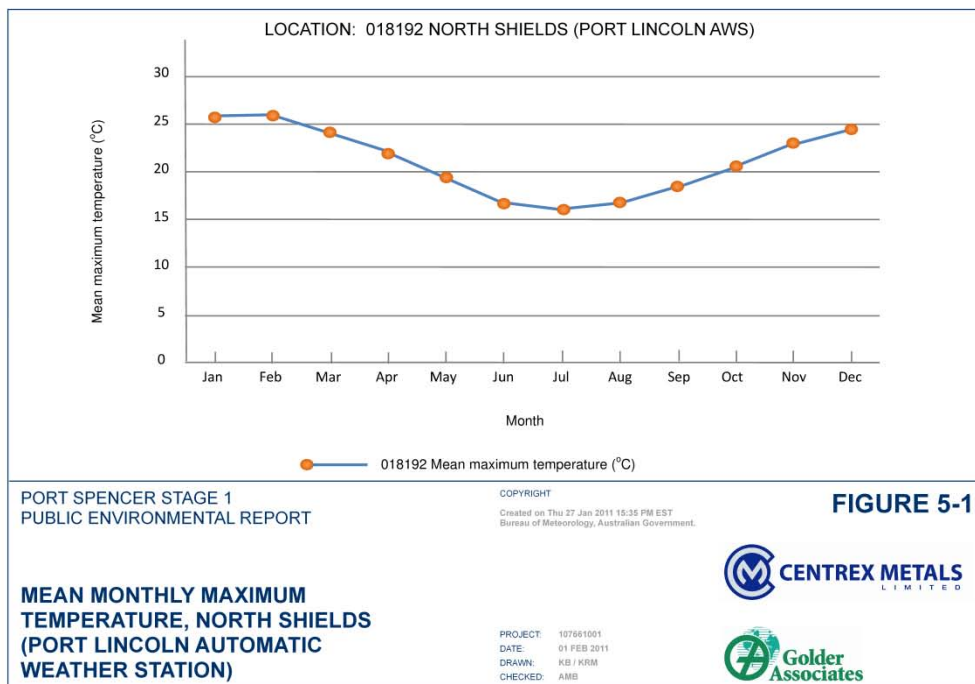
5.1.2 Climate Change

Climate change refers to change in mean and/or variability of climate properties that persists for an extended period, typically decades or longer (Intergovernmental Panel on Climate Change (IPCC), 2007). Temperature, rainfall, evapotranspiration and sea level are climate properties that can potentially affect the stability or integrity of infrastructure and must be addressed through appropriate design. Climate change and related studies are playing an important role in determining the potential impacts of global warming at a regional and global scale. As the Project resides close to oceanic and dry environments, the potential impacts of climate change are taken into consideration as part of project impact assessment and design.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has provided studies displaying the potential high and low climate change scenarios for the southern parts of South Australia including the Eyre Peninsula. These studies provide potential climate change risk scenarios until 2030, relative to 1990 records, and indicate that southern parts of South Australia are likely to become warmer with more hot days and fewer cold nights (Table 5-1). Generally, the South Australian region is expected to experience increased temperatures, lower rainfall, higher evapotranspiration and changes in ocean wave climate in future. However, the effects are not uniform: for example, an increase in high intensity storms accompanies predictions of lower total rainfall.

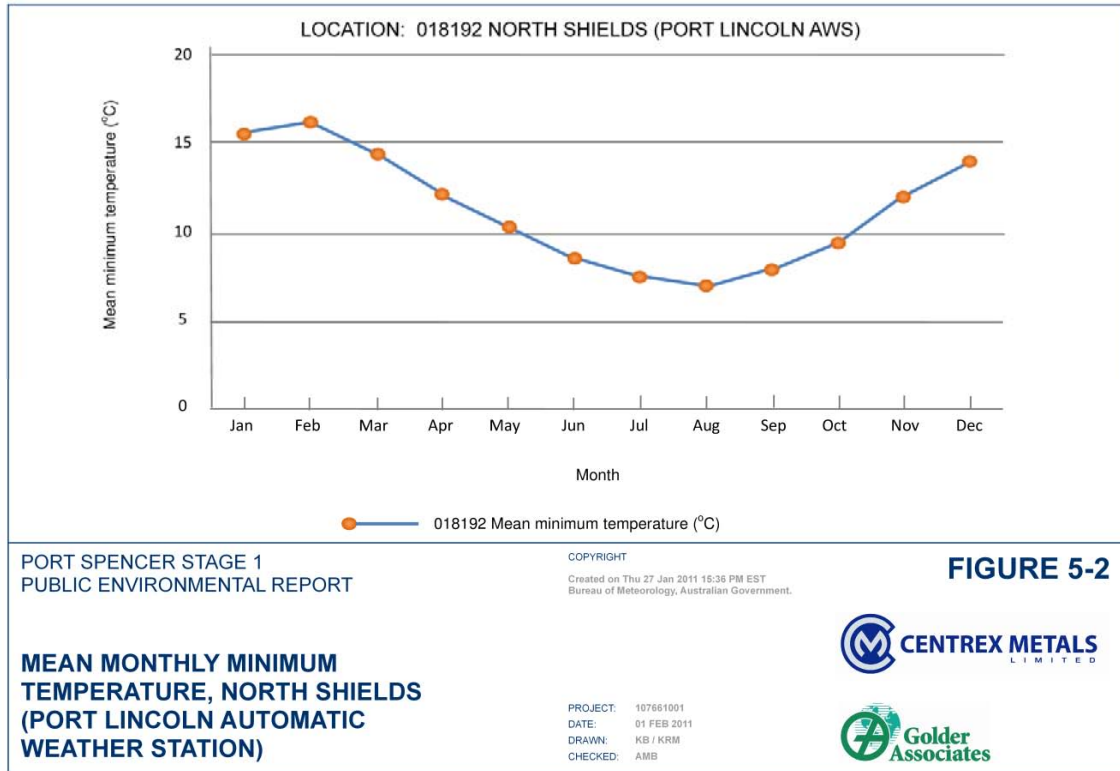
Due to these potential climate change scenarios energy demands are likely to become greater with the need for increased cooling in summer. Water resources are likely to come under further stress due to “climate driven changes in supply for irrigation, cities and industries and environmental flows”. It is thought that with a decline in annual rainfall, less run-off due to higher evaporation rate would become apparent. The occurrences of droughts are likely to become more frequent and more severe (CSIRO, 2006b).

Figure 5-1: Mean Monthly Maximum Temperature, North Shields (Port Lincoln Automatic Weather Station)



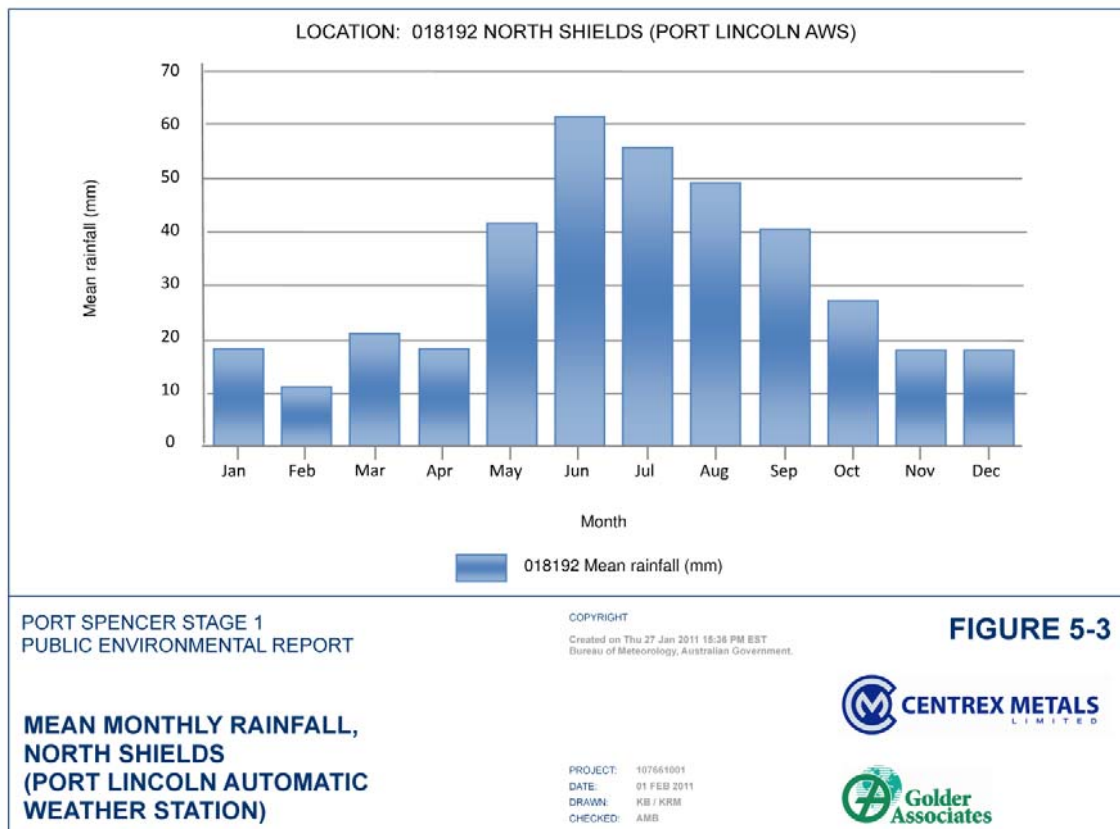
Source: Bureau of Meteorology, 2011

Figure 5-2: Mean Monthly Minimum Temperature, North Shields (Port Lincoln Automatic Weather Station)



Source: Bureau of Meteorology, 2011

Figure 5-3: Annual Rainfall



Source: Bureau of Meteorology, 2011

Table 5-1: Predicted Climate Change for Southern South Australia by 2030 Relative to 1990

Feature	Low Global Warming Scenario		High Global Warming Scenario	
	Estimate of Change	Uncertainty	Estimate of Change	Uncertainty
Annual Average Temperature	+0.4 °C	± 0.2 °C	+0.9 °C	± 0.6 °C
Average Sea Level Change	+3 cm	N/A	+17 cm	N/A
Annual Average Rainfall	- 3%	± 3%	- 7.5 %	± 7.5%
Seasonal Average Rainfall Winter and Spring	-5%	± 5%	-11%	± 11%
Seasonal Average Rainfall Summer	-3%	± 6.5%	- 7.5 %	± 15%
Seasonal Average Rainfall Autumn	-1.5%	± 5%	-3.5%	± 11%
Annual Average Potential Evaporation	+1.6 %	± 1.1%	+3.7%	± 2.5%
Carbon Dioxide Concentration	+73 ppm	N/A	+102 ppm	N/A

Source: CSIRO, 2006

5.1.2.1 Temperature, Rainfall and Evapotranspiration

Table 5-2 summarises projected changes in temperature, rainfall and evapotranspiration for the Eyre Peninsula based on a medium emissions scenario⁸. The changes are presented relative to the statistical probability of occurrence (10th, 50th and 90th percentile).

Table 5-2: Summary of Climate Change Projections for 2030 on the Eyre Peninsula

Climate Change Projection for 2030 in the Eyre Peninsula				
Variable	Season	10 th percentile	50 th percentile	90 th percentile
Temperature (°C)	Annual	0.5	0.8	1.3
	Summer	0.5	0.8	1.3
	Autumn	0.5	0.8	1.3
	Winter	0.5	0.8	1.3
	Spring	0.5	0.8	1.3
Rainfall (%)	Annual	-15	-3.5	0
	Summer	-15	-3.5	7.5
	Autumn	-15	-3.5	7.5
	Winter	-15	-7.5	0
	Spring	-15	-7.5	0
Potential evapotranspiration (%)	Annual	0	3	3
	Summer	0	0	3
	Autumn	0	3	6
	Winter	0	6	10
	Spring	0	0	3

Source: DENR, 2010

⁸ Medium emissions scenario refers to Scenario A1B of the 2000 Intergovernmental Panel on Climate Change's Special Report on Emissions Scenarios. This scenario reflects rapid economic growth with a balanced emphasis on fossil-intensive and non-fossil energy sources.

The figures in Table 5-2 show that by 2030 under the medium emissions scenario, the estimate (50th percentile) for temperature, rainfall and evapotranspiration is:

- Annual temperatures to increase by 0.8°C.
- Annual rainfall to reduce by 3.5%, and
- Annual potential evapotranspiration to increase by 3.0%.

5.1.2.2 Sea Level Rise

Information on the projected change in sea level published by DCCEE (2011) has three global sea level rise scenarios as shown in Table 5-3.

Table 5-3: Three Global Sea Level Rise Scenarios, 2030-2100 (Relative to 1990 Levels)

Year	Low scenario ¹	Medium scenario ²	High scenario ³
2030	0.13 m	0.15 m	0.2 m
2070	0.3 m	0.5 m	0.7 m
2100	0.5 m	0.8 m	1.1 m

Source: DCCEE, 2011

¹The low scenario represents sea level rise that is likely to be unavoidable due to predicted climate change scenarios.

²The medium scenario refers to sea level rise projected with current greenhouse gas emissions and observations of sea level rise.

³The high scenario includes consideration of increased sea level rise associated with more recent information on ice sheet dynamics.

The figures in Table 5-3 show that by 2030 under the medium scenario, sea level is estimated to rise by 0.15 m and in 2100 by 0.8 m. The regional rate of risk of sea level rise for Eyre Peninsula remains unknown; hence, the projected sea level rise for the Australian coast relative to 1990 levels has been used for this PER.

The impacts of projected sea level rise could also be experienced through storm surge events and wave variability. Storm patterns may not change greatly, but may become slightly less frequent and slightly more intense in South Australia.

5.1.2.3 Ocean Wave

Changing wind systems projected to occur would have the effect of altering the surface ocean wave energy. Information on the projected change in wave climate on Australia's southern coasts is shown in Figure 5-4, as the expected changes in wave height for the Eyre Peninsula. Figure 5-4 and shows an increase of between 0.5 m and 1.0 m at the Port site.

Possible impacts of changing ocean waves on the existing environment are:

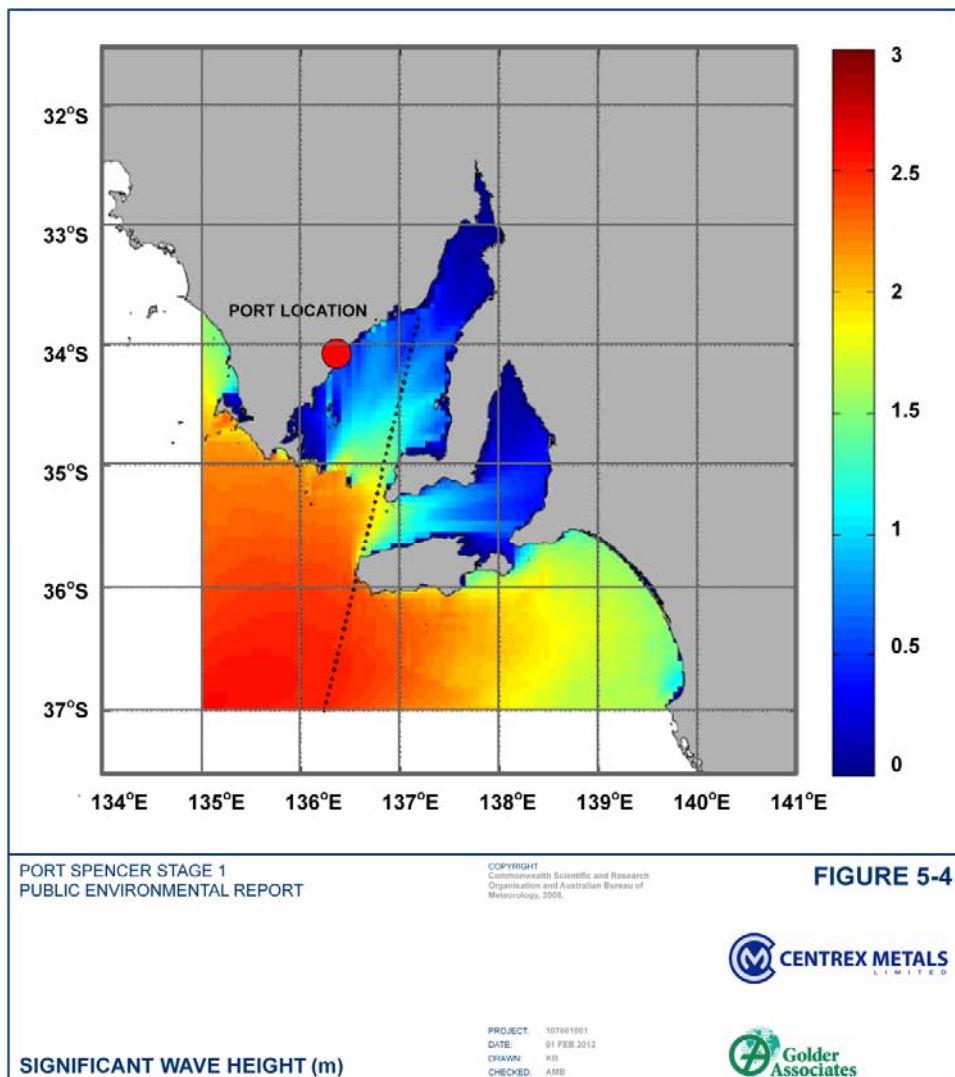
- Coastal inundation during severe storm events through the combined effects of sea level rise, storm surge, and ocean waves (Figure 5-5).
- Coastal erosion brought about by large wave events, or changes in wave direction shifting coastal sand and sediment, and
- Seabed disturbance impacting sub tidal habitats.

5.1.3 Storm Surge

Storm surge is the amount by which meteorological conditions cause a tide to rise above the predicted astronomic tide. It is caused by changes in barometric pressure and by wind stress on the sea surface. While storm surge seldom exceeds 1.0 m on the state’s open ocean coastline, surges of 1.4 m and 2.0 m above predicted high tides have been recorded at Port Adelaide and Port Pirie, respectively. A large storm surge occurring concurrently with a high spring tide will cause the highest tides. Conversely, an intense storm may not cause damage if it occurs during a period of neap tides (a generally low tidal range between low and high tides) or is of short duration and coincides with low tide.

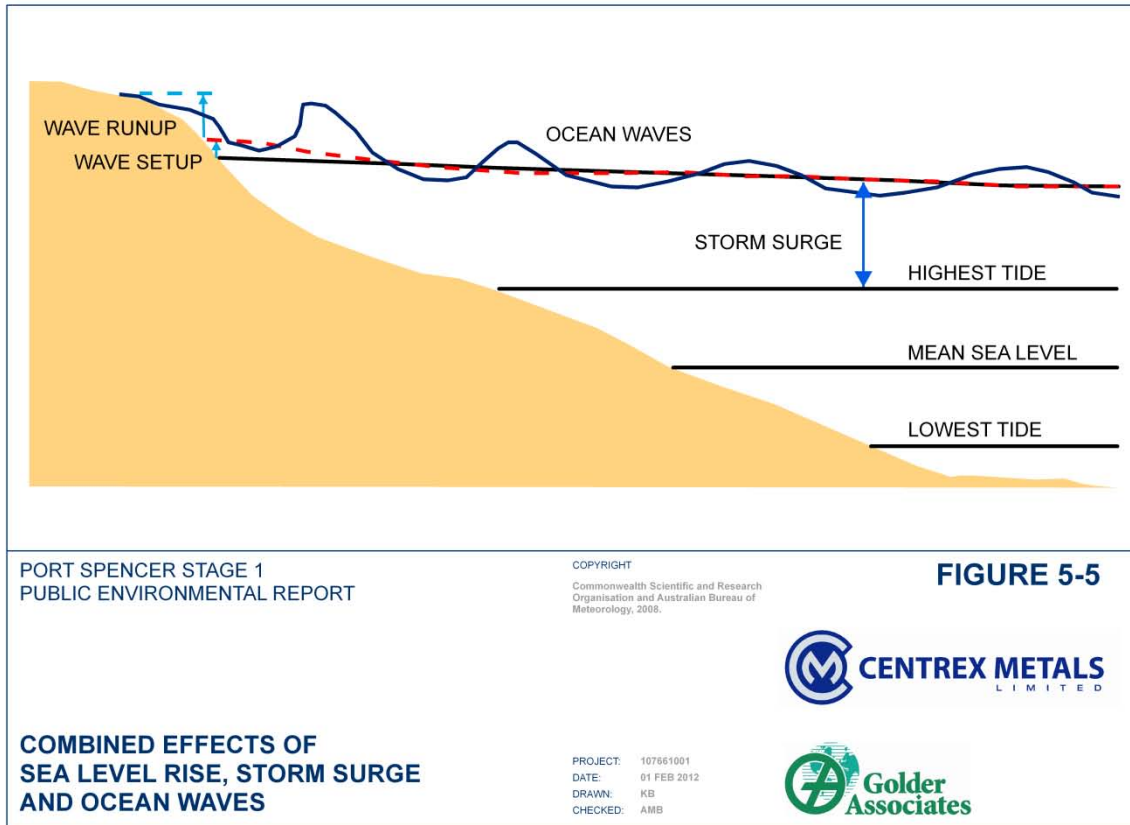
It is rarely necessary to design a development to be safe against the highest possible tide, because there is low probability of this occurring. However, the design should conform to an agreed risk level, which should be consistent with risks accepted for other hazards, such as urban flooding. The Tumbly Bay (DC) Development Plan (2011) establishes the 100 year average recurrence interval (ARI) water level as the standard for coastal development in South Australia. The 100 year ARI event has a 1 in 100 chance of occurring or being exceeded in any year. It is usually obtained by statistical analysis of tide records.

Figure 5-4: Significant Wave Height (m)



Source: CSIRO and BOM 2008

Figure 5-5: Combined Effects of Sea Level Rise, Storm Surge and Ocean Waves



Source: CSIRO and BOM, 2008

5.2 Land Use

The Port site tenure details are summarised in Table 5-4. Figure 5-6 presents the Port site boundary together with each of the allotment number and boundaries.

Table 5-4: Project Site Tenure Detail

Council	District Council of Tumby Bay			
Allotment Number	386	387	388	389
Plan Details	CT6037/404 H511600 Parcel S386	CT6066/698 H511600 Parcel S387	CT6037/404 SEC 386 LT 23 D78441 D78441 A23	CT6066/698 D78441 A24
Tenure	Freehold	Freehold	Freehold	Freehold
Current Owner	Centrex Metals Limited	Centrex Metals Limited	Centrex Metals Limited	Centrex Metals Limited
Plan Area of Site (approximately)	53 ha	16.7 ha	51 ha	17 ha
Zone	General Farming	General Farming	Coastal	Coastal

The majority of the Project area was historically used for agricultural activities (Golder, 2009d). Only the western portion of the Project area is still cultivated with wheat. Apart from some fence lines, no built infrastructure exists in the Project area. The coastal allotments (Allotment Numbers 388 and 389) within the Project area have not been disturbed previously.

As discussed in Section 3.4.5, the Port is located within two zones: coastal zone and general farming zone. The zone boundaries are shown in Figure 5-6. The Port is currently free of built development and has largely been cleared of native vegetation for fallow paddock or wheat cropping purposes. No significant trees are present and native vegetation is restricted to the coastal zone. No matters of national or state significant flora or fauna have been identified, although the remnant coastal native vegetation that persists is of regional importance. The adjacent land uses include grazing and crop farming activities. A private beach, locally called Rogers Beach (including a small dune area), is immediately north of the Project and would be considered a development exclusion zone.

5.2.1 Topography

The Port site is in an undulating area, with the shore line on the eastern site boundary. The headland is characterised by rocky outcrops between Rogers Beach and Lipson Cove Beach and drops off steeply to a rocky shoreline. The headland where the proposed jetty will be constructed rises from the coastline at the east of the site to approximately 25 m AHD. Moving west from the headland, the land slopes down towards the valley in the centre of the Project area to an elevation of approximately 10 m AHD where it begins to rise towards Swaffers Road.

Swaffers Road rises from its eastern end along a valley until it reaches a high point at the Coast Road intersection. Between Coast Road and the Lincoln Highway, Swaffers Road gradually falls through a series of hills and valleys.

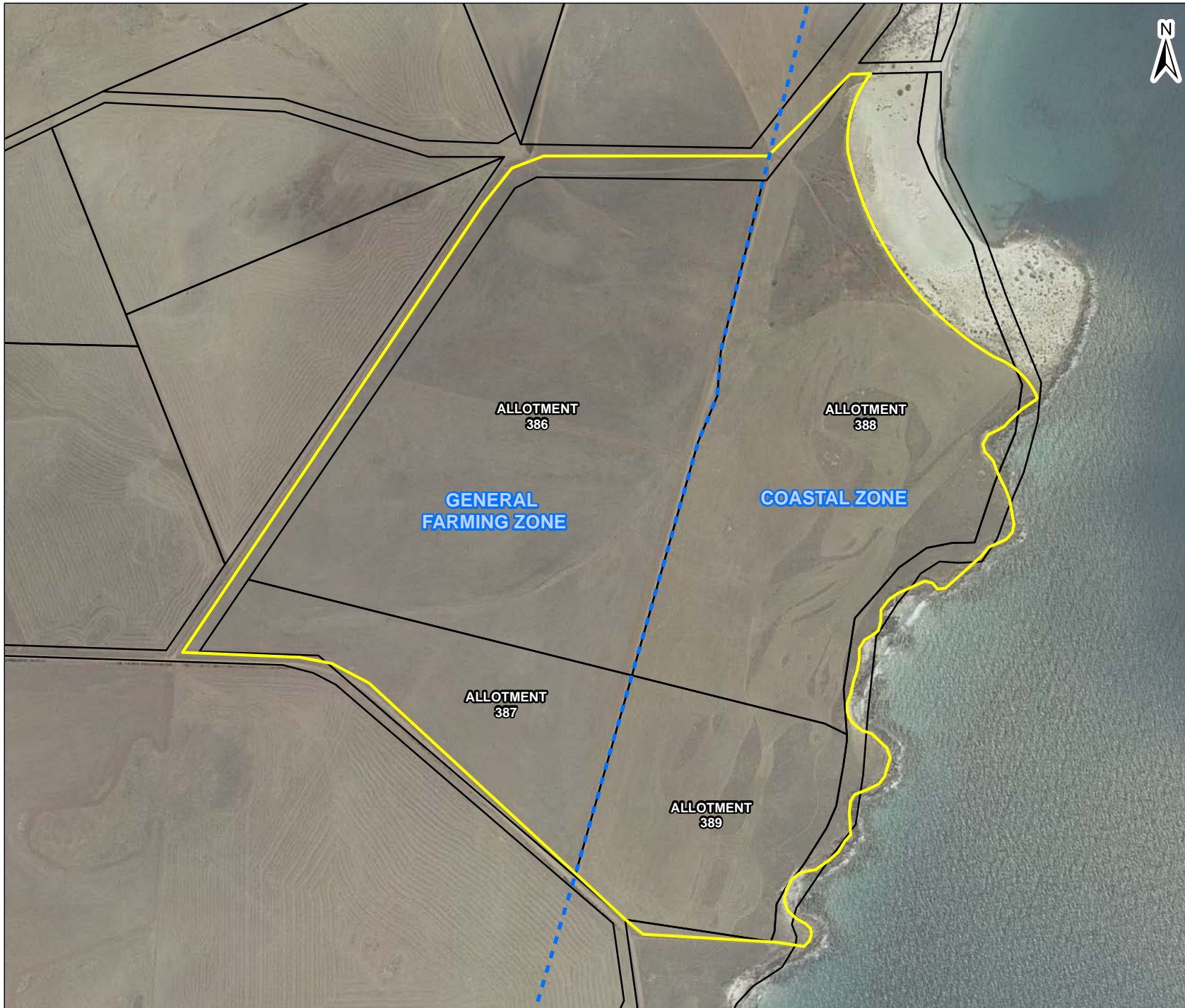
Two areas along Swaffers Road were identified as natural water collection areas. One of these is located 1 km west of Coast Road and the other is located at the Swaffers Road – Lincoln Highway intersection, to the north of Swaffers Road (Golder, 2009d).

5.3 Geology and Soils

In 2008, a soil characteristics study was undertaken for the Project area. The report of the soil assessment can be found in Appendix D. The aims of the soil study were to assess the erosion hazard potential of the soil types identified at the Project area, characterise the soil profiles, assess for the presence of highly sodic or saline soils, assess chemical characteristics of soils, and potential constraints the soil types may pose to development and revegetation.

The study included soil assessment on Allotment Numbers 386 and 388 in the northern portion of the Project area. Allotment Numbers 387 and 389 were not assessed as Centrex did not have access to these allotments during that time. Tenure details and allotment boundaries are presented in Table 5-4 and Figure 5-6.


For the purpose of the soil assessment, allotment numbers 386 and 388 were divided into three areas. From study results, it can be inferred that the condition is fairly uniform in each of the areas and there are no clear reasons as to why the southern portion of the Project area would vary from the studied northern portion.



**EXISTING ALLOTMENT
BOUNDARIES
AND COUNCIL ZONING**

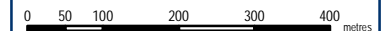


LEGEND

-  Allotment Boundaries
-  Council Zoning Boundary
-  Project Boundary

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bing
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 Aerial image sourced from Department for Environment and Heritage, South Australian Government.
 Cadastral data sourced from Department of Environment and Natural Resources (DENR), South Australian Government, date sourced 23.09.2011.
 Township data sourced from MapInfo StreetPro.



SCALE (AT A4) 1:10,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB / KRM
 CHECKED: AMB

FIGURE 5-6



5.3.1 Geology

The Lincoln mapsheet (Figure 5-7) indicates that the proposed Port and transport corridor (Swaffers Road) is underlain by Archean age “*Undifferentiated metasediments, coarse grained augen gneisses, granitoid gneisses, amphibolites, mica schists, sericite schists. Doleritic dykes abundant along eastern coast*” (Johns et al., 1958).

This description of the site geology is consistent with the Tumby and Neill mapsheets. It is understood the site is located in the Kalinjala Shear Zone. This is a large-scale crustal structure on the Eyre Peninsula which separates the Donington Suite granites to the east from metasedimentary schist, quartzite, dolomite marble and banded iron formations of the Hutchison Group to the west.

The rocks beneath the site and exposed at the nearby beaches are granite, granitic gneiss (deformed and metamorphosed granite), and schist (extremely deformed sheared granite). The granites and gneiss are likely to belong to the Donington Suite. These were intruded in a long belt along the east coast of the Eyre Peninsula, under the southern Spencer Gulf and outcrop also at the foot of the Yorke Peninsula. The schists may represent a subsidiary shear zone, possibly splintering off the main shear zone (Golder, 2009f).

5.3.2 Soil Characteristics

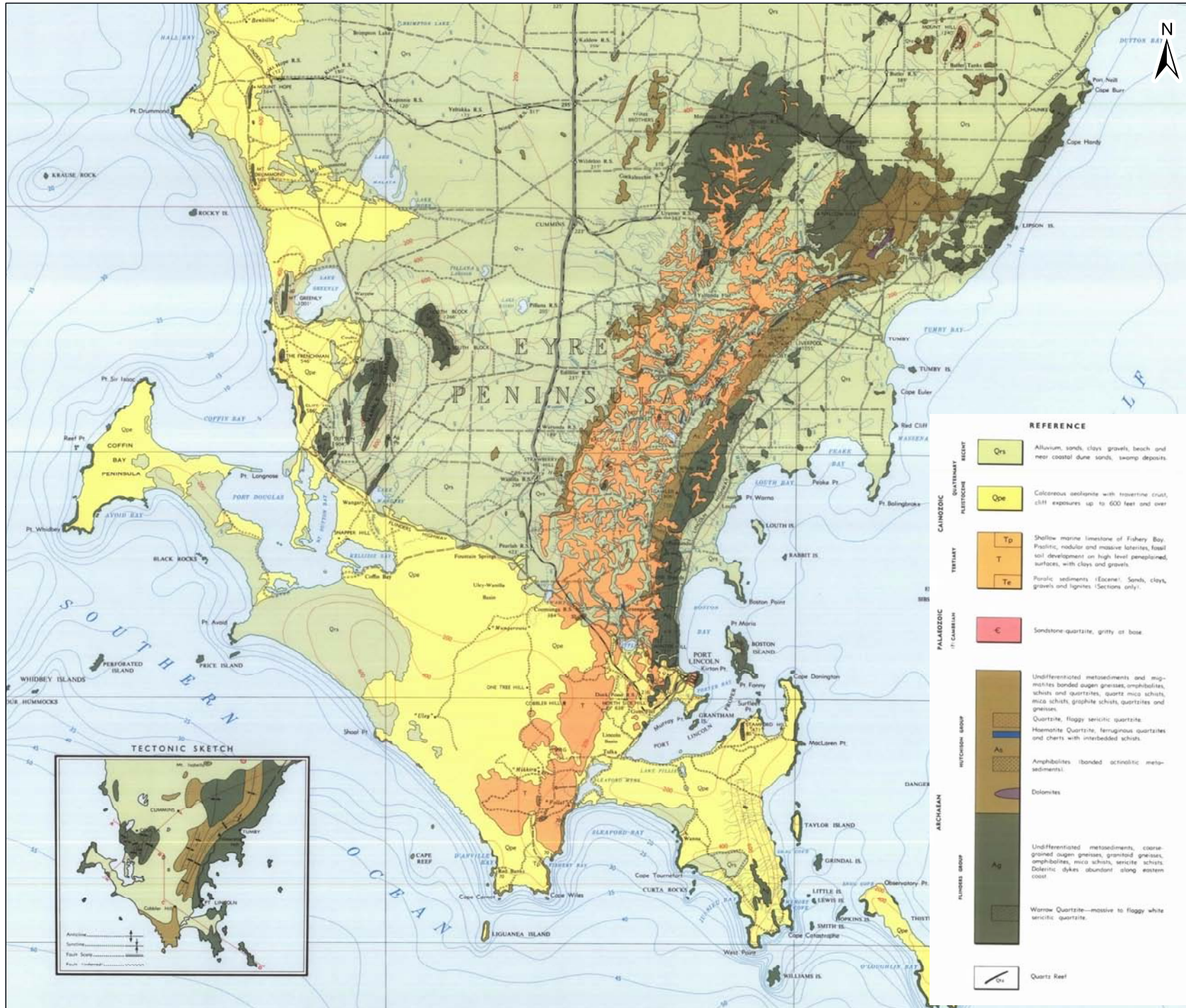
The Soil Map of South Australia suggests that the dominant soil type in the Project area (and most of the east coast of the Eyre Peninsula) is ‘*Calcareous Sands: Coorong coastal dune formations*’.

The soil profiles local to the Project area are classified in accordance with ‘*The Australian Soil Classification*’ (Isbell, 2002) system as predominantly:

- Sodosols – Soils with strong texture contrast between the surface layer and sodic subsurface layer. Sodic soils hold sufficient sodium to be used for plants, including crops, and
- Tenosols – Soils with generally weak vertical soil profile, except in the surface layer.

The Australian Soil Resource Information System (ASRIS) (CSIRO, 2006a) contains data on the probability of acid sulfate soils across Australia. Acid sulfate soils are sediments of organic matter and can naturally occur in waterlogged conditions. These soils can form sulfuric acid when in contact with oxygen. It is not ideal to disturb acid sulfate soils in the natural environment. The ASRIS data shows that for land on the western side of the Project area, there is ‘extremely low probability’ of the presence of acid sulfate soils. The remainder of the Project area is unmapped for acid sulfate soils. Around 500 m to the south of the Project area there are two areas with ‘high probability’ of the presence of acid sulphate soils.

LINCOLN GEOLOGY
MAPSHEET



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RK Johns, D Thatcher, ES O'Driscoll, Lincoln Map Sheet, 1:250 000, Geological Survey of South Australia (1958).

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FIGURE 5-7



5.3.2.1 Field Assessment for Potential Contaminants

Intrusive soil investigation was undertaken in the Project area and along Swaffers Road to assess physical and chemical properties of the soil. Standard penetration tests and dynamic cone penetrometer tests were used to obtain measurements on soil strength. A photoionisation detector was used to assess the presence of volatile organic compounds in the soil. Soil samples were collected both from the surface and underground and sent for chemical analysis to an accredited laboratory. The intrusive soil test locations and full description of the field assessment is presented in Appendix D.

Selected samples of soil were analysed for all or some of the following chemical analytes: pH, silver, molybdenum, selenium, tin, aluminium, arsenic, cadmium, chromium, copper, iron, magnesium, mercury, nickel, lead, zinc, mercury, hexavalent chromium, cyanide, fluoride, polychlorinated biphenyls (PCBs), volatile halogenated compounds (VHOCs), phenolic compounds, organochloride pesticides (OCP), organophosphate pesticides (OPP), total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzenes and xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAH).

The results of the chemical analyses were compared with published Australian guidelines to assess the potential for contaminated soil to impact on the health of potential site users and environmental receptors. The guidelines are also used to assess off-site disposal options. The primary soil guidelines consulted were as follows:

- *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) (National Environment Protection Council 1999)*
 - The NEPM provides guidance for the investigation and management of site contamination, and provides health-based investigation levels (HILs) for soils in nominated settings (e.g. standard residential, residential with minimum opportunities for soil access, and commercial/industrial) and interim ecological investigation levels (EILs) for soils in an urban setting. As the proposed future land use of the site is a port, the NEPM HIL commercial/industrial and the NEPM EILs were applied.
- *Environment Protection (Fees and Levy) Regulations (1994), Schedule 6*
 - This schedule provides limiting concentrations of chemical substances in soil for off-site disposal as 'waste fill'. Waste fill is soil that can be disposed of to landfill without incurring a waste levy.

Results of the chemical soil analysis indicated that chemical concentrations were generally below the laboratory limit of reporting or below the adopted guidelines for disposal and for the protection of human health and ecological receptors. There were samples with concentrations of copper, zinc, vanadium and TPH exceeding the NEPM EIL guidelines and waste fill disposal criteria. However, sample concentrations were below the NEPM HIL commercial/industrial guidelines for commercial/industrial land use. Also, the 95% upper confidence limits of mean analyte concentrations were below the NEPM EIL guidelines and waste fill disposal criteria.

The measured pH values ranged from 6.5 to 10.3. pH values above 9.0 are considered to be elevated and alkaline. However, the measurements for samples recovered from the Project area and transport corridor are likely to be regionally influenced, with elevated measurements attributable to the prevalence of calcareous formations in the area. This is typical of the Eyre Peninsula.

5.4 Surface Water

A surface water conceptual design and management strategy analysis for the Port was conducted and the full report of the conceptual design and management strategy can be found in Appendix F.

A site visit and hydrologic analysis was performed for the existing site conditions and development conditions. The results of the hydrologic analysis were used to develop a conceptual stormwater conveyance design. Recommended strategy and relevant guidelines have been provided for stormwater management during construction and operation of the Port. Appendix F includes the following:

- Existing conditions surface water site investigation
- Desktop review of relevant stormwater regulatory and management guidelines
- Stormwater runoff hydrology:
 - 100-year Annual Recurrence Intervals (ARI) for existing conditions, and
 - 10-year and 100-year ARI for proposed conditions.
- Conceptual design of stormwater improvements for proposed conditions:
 - On-site stormwater extended detention basin, and
 - Off-site diversion channels, culverts and related stormwater improvements.

5.4.1 Surface Water Existing Conditions

The climate is semi-arid with average annual rainfall of 385 mm. The majority of precipitation falls in the winter months and evaporation rates are high relative to rainfall. This tends to result in low stormwater runoff during the more frequent and smaller storm events.

The existing catchment at the Port drains to Rogers Beach. Figure 5-8 shows the existing surface water conditions catchment, project boundary and summary of existing conditions storm runoff for the 100 year storm event. The total catchment area contributing to runoff at Rogers Beach is of approximately 910 ha (9.1 km²). Land use in the catchment is comprised of undeveloped land and agricultural use with no impervious surfaces. Roads are compacted gravel or earthen and there are only three residences within the catchment. Agricultural use consists of fallow paddock and wheat cropping. Pollutants of concern for these types of land use categories include, but are not limited to sediment, agricultural chemicals, fertiliser, animal faeces, and putrescible waste, green and hard waste.

The soil study (refer Appendix D) and surface water study (refer Appendix F) found erosion that varied from minimal to large. In general, the overall catchment showed little erosion in the areas exhibiting signs of overland and concentrated runoff. Catchment drainage in an upper reach adjacent to Swaffers Road and running down to the farmhouse exhibited large channel incision and erosion at the end of the culverts under the driveway.

The surface water study included a limited assessment of soils and surface water and groundwater interaction. Groundwater depths vary across the site and range from 9 m deep on the west of the Project area to as shallow as 1.7 m deep in the flat zone in the north-east of the Port. Surface soils across the Project area and Port Spencer catchment are typically fine to coarse clayey sand, clayey silt. No standing water or groundwater seepage was observed during the various site visits.

Results of the existing conditions 100 year Average Recurrence Interval (ARI) event runoff analysis for the existing catchment conditions is summarised in Table 5-5. The estimated total catchment runoff for the existing conditions at the flat zone adjacent to Rogers Beach is approximately 68 m³/s.

EXISTING SURFACE
WATER CATCHMENT
CONDITIONS



LEGEND

- Catchment Boundary and Label
- Project Boundary
- Contour (m AHD)
- Drainage Pattern
- A=** Catchment Area, ha
- Catchment Runoff Combination Point
- Q₁₀₀**= Peak Flow Rate (m³/s)

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Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011. Lidar contour data sourced from Centrex Metals Ltd, February 2011.

0 125 250 500 750 1,000 metres

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FIGURE 5-8

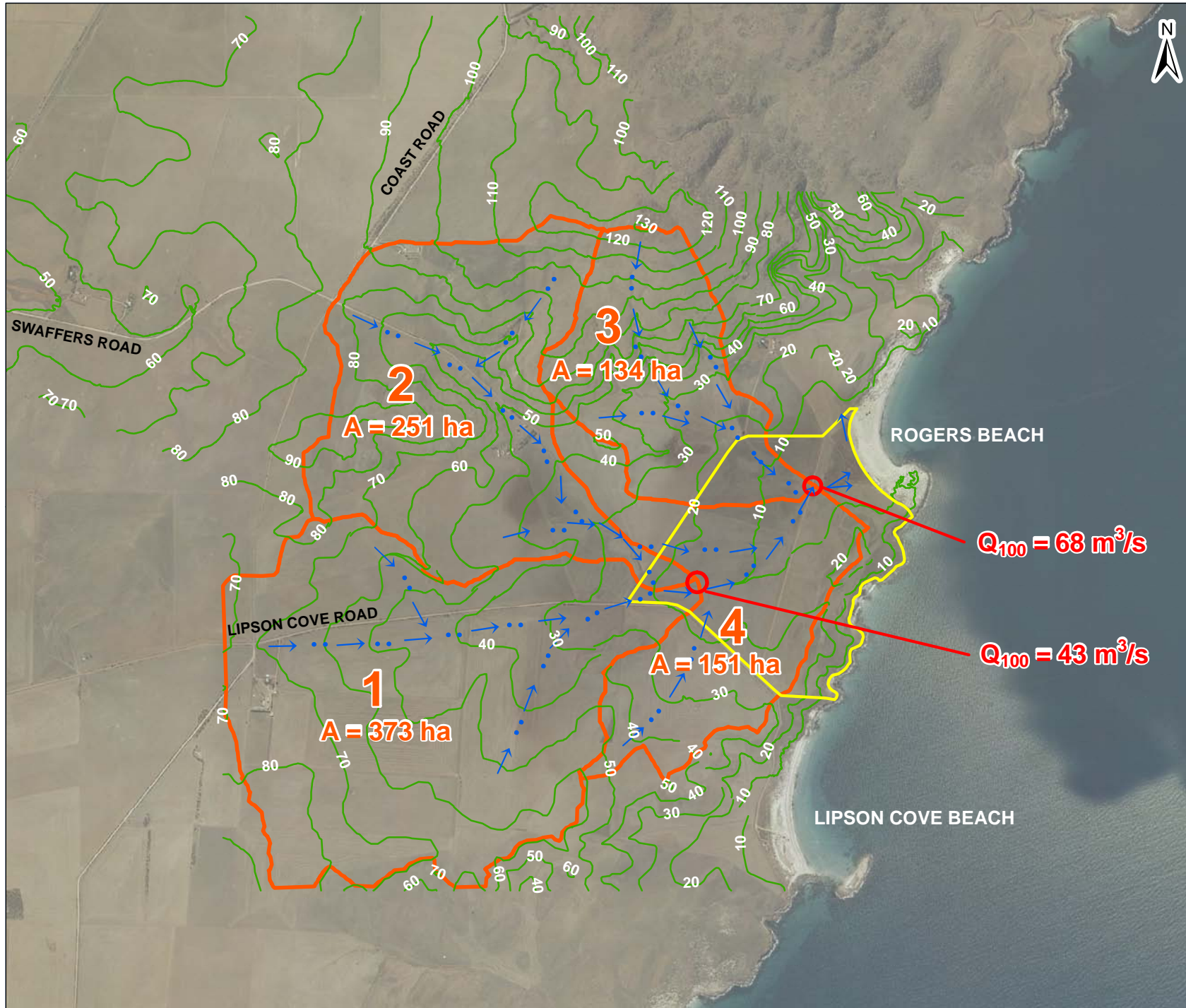


Table 5-5: Summary of Existing Conditions Storm Runoff for 100 year ARI

Catchment	Area (ha)	Slope (%)	Approximate Runoff Peak Flow (m ³ /s)
1	373	2.85	43
2	251	5.29	
3	134	6.97	68
4	151	3.19	
Total	909	-	-

5.5 Groundwater

A groundwater assessment of the Project area was conducted in 2008. The full report of groundwater assessment can be found in Appendix E. Boreholes that were drilled during the soil study were converted to groundwater wells. The locations of groundwater wells are therefore identical to the locations of soil assessment boreholes. Figure 5-9 presents the location of groundwater wells and groundwater height contours based on the groundwater depth obtained from these wells.

5.5.1 Underground Environment (Hydrostratigraphy)

A single, multi-lithology aquifer is inferred beneath the site (refer Appendix E). Groundwater in this aquifer is just above mean sea level at <3 m Australian Height Datum (AHD) in either fractured rocks or unconsolidated sediments. The unconsolidated sediments above the fractured rocks (i.e. granite, gneiss or schist) are either a thin (i.e. few metres thick) layer of extremely weathered rock, or unconsolidated recent sediments (approximately 10 m thick). This uppermost aquifer is likely to be unconfined and potentially the receiving environment for contaminants released to the land surface or just below.

There is no data available on the groundwater in the deep fractured rock aquifer. It is not likely that low salinity groundwater is present at depth in the fractured rock aquifer. Generally, groundwater adjacent marine environments tends to be more saline. The overlying unconsolidated aquifer is more likely to store low salinity groundwater. Based on this data, a fresh-saline interface is expected to be close to sea level adjacent the coast.

5.5.2 Lateral Groundwater Flow

Figure 5-9 shows measured groundwater elevations in the groundwater wells (in m AHD) and likely groundwater head contours. The groundwater elevation at the coastline is assumed to be close to the elevation of the water in the adjacent marine environment for the purpose of this map.

The general geology and hydrogeology of the site is understood to be a fractured rock basement overlain by unconsolidated sediments. The unconsolidated sediments are likely to be Recent sediments related to the adjacent marine environment. Regionally, it is understood that the groundwater flow direction is toward the coast and primarily hosted in the fractured basement rock.

Based on this understanding of the regional and site geology and on the measured groundwater elevation data, it appears groundwater flow direction at the site is driven predominantly by local geology. Based on the groundwater elevations measured in the investigation area, the groundwater appears to be flowing from the fractured rock system in the area of groundwater wells GW01, GW04 and GW06 toward the surrounding areas of unconsolidated sediments. These sediments are located on the coastline to the east and Rogers Beach and the adjacent back-beach. Based on this assumption, Rogers Beach and the back-beach is likely receiving water from the fractured rock system to the north of the site. The likely groundwater flow directions are indicated on Figure 5-9. Based on these contours, the most likely receptor of groundwater is the area of Rogers Beach and subsequently the adjacent marine environment.

Assuming the groundwater system is isotropic (flows uniformly in all directions) groundwater movement would be perpendicular to the contours. Groundwater appears to move from a ridge towards the east (sea), north (to Rogers Beach) and west/north-west. The north-westerly flow appears to be primary direction as it connects the fractured rock environment to the sedimentary deposits. The fractured rock contains the groundwater beneath the sediments encountered and on the surface adjoining a drainage feature that terminates in a flat zone adjacent to Rogers Beach. The flat zone appears to be the most likely receptor of surface water and the majority of groundwater flows. The likely flow direction of groundwater is shown in Figure 5-9.

5.5.3 Groundwater Recharge

Bureau of Meteorology (BOM) data indicates the average annual rainfall for the area is 385 mm and the average annual evaporation is likely to be about 1,500 mm. Recharge to groundwater is expected to occur almost exclusively in winter because that is when most rains fall (between June and August) and temperatures (and hence evaporation) are lower. The hot and mostly dry summer, between the months of December to March, is characterised by large evaporation losses from surface water and groundwater close to the surface.

Over 80 Australian groundwater recharge studies were reviewed by Petheram et al. (2000). In general, it is suggested groundwater recharge was found, at around 500 mm/y rainfall, to be up to 75 mm/year. Using a recharge range of 25 to 75 mm/year and assuming a porosity of 5% for the fractured rock, an annual fluctuation of about < 0.5 to 1.5 m in groundwater levels is expected.

5.5.4 Groundwater Discharge

Regionally, groundwater is understood to eventually discharge to the marine environment of Spencer Gulf. Based on groundwater level measurement at the site, groundwater is expected to discharge the marine environment to the east of the site and also to the marine environment via Rogers Beach and the back-beach environment. During site works no groundwater seepage to surface was observed.

5.5.5 Groundwater Quality

Monitoring wells were installed along with the soil investigation (borehole drilling) program. A total of eight wells were installed to a maximum depth of 21.5 m. The wells were constructed to intersect the uppermost groundwater table either in fractured rock or in unconsolidated sediments (Appendix E). The locations of these wells are shown in Figure 5-9.

The results of the chemical analyses were compared with published applicable guidelines to assess the potential for contaminated groundwater to impact on the health of potential site users and environmental receptors. The South Australian Environment Protection Authority (SA EPA) stipulates the use of *Environment Protection (Water Quality) Policy 2003* (EPP(WQ)) for assessing water quality. Given the likely future land use of the site (commercial/industrial), the generally low groundwater yields and the site setting, (adjacent to Spencer Gulf), the most applicable criteria provided in the EPP(WQ) are considered to be for the protection of marine aquatic ecosystems.

Regional groundwater data reported by PIRSA indicated brackish to saline water under the Project area. Total dissolved solids (TDS) range between freshwater (786 mg/L at GW05) to brackish/saline water (maximum 19,500 mg/L at GW07). All the reported groundwater samples are of a quality typical of coastal groundwater discharge areas. The reported pH values are between 6.85 and 9.52 with a median of 7.85. This is typical of the calcareous nature of the region.

Metal exceedances for mercury, cadmium, manganese, molybdenum, selenium, zinc, or silver were found in all boreholes (but no borehole consistently exceeded all of the metal guidelines) and in an unpredictable pattern. Considering the current land use and the general lack of potential contaminants, the most likely explanation is that the metals occur naturally and are the product of groundwater–metamorphic rock interaction. Other organic compounds including pesticides and herbicides analysed were below their respective limits for reporting.



PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

GROUNDWATER WELL
LOCATIONS AND
GROUNDWATER
CONTOURS



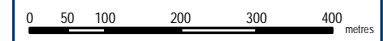
LEGEND

- Groundwater Well Location and Measured Groundwater Level, m AHD
- Inferred Groundwater Contour m AHD
- Project Boundary
- Direction of Flow

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FIGURE 5-9



5.6 Air Quality

Assessment was undertaken of the existing air quality and the detailed impact assessment report is provided in Appendix C.

The local landscape and meteorology are important considerations in terms of how emissions in the air are dispersed, concentration of contaminants and the proximity of sensitive land use locations. The climate of the Project area is described in Section 5.1. The Project is predominantly green-field and the surrounding area is exclusively agricultural. Sources of dust from human activity in the region include the following:

- Motor vehicle exhausts
- Industrial processes
- Heating and power generation
- Stock movements, and
- Fuel reduction burning.

Natural sources of dust in the region include the following:

- Wind erosion, and
- Bushfires initiated by lightning strikes.

There may be some power generated by diesel engines on farms. There is little urbanisation in the vicinity of the Project area, and emissions from combustion engines are not produced in great quantities. The major source of particulate matter in the region is dust eroded by the wind. Larger eroded dust particles tend to settle, leaving fine particles as the majority of dust in the atmosphere over long distances.

5.6.1 Background Air Quality and Land Use

Air quality monitoring information was taken from the closest ambient air quality monitoring stations to the Project, located at Whyalla, which lies approximately 250 km to the north-east and Port Pirie, which lies approximately 280 km to the north-east. These sites are situated in urban environments with significant heavy industry located in the respective regions and are considered worst case scenario compared to Port Spencer. There was no site specific data available at the time of assessment.

Particulate matter (PM) relates to particles of solid matter suspended in the air. Particulate matter smaller than 10 micrometres in diameter are referred to as PM₁₀. Particulate matter smaller than 2.5 micrometres in diameter are referred to as PM_{2.5}. These are the generally accepted measures of particulate material.

Data averaged from the monitoring stations showed a PM₁₀ concentration of 23 µg/m³. Concentrations of PM_{2.5} in urban environments are typically 40-50% of the PM₁₀ concentration, and in the absence of PM_{2.5} background data, it was conservatively assumed that the representative PM_{2.5} background concentration was equal to 50% of the PM₁₀ concentration; 11 µg/m³.

Locations were identified that would be sensitive to potential PM₁₀ and PM_{2.5} impacts within the 25 km² study area around the Project. Sensitive land uses identified included the following:

- Residences (either isolated or in clusters)
- Hospitals (not present)
- Schools (not present)
- Day-care centres (not present)
- Public open space (not present), and
- Aged care facilities (not present).

The Port is located in a rural area, consequently the main sensitive receptors are likely to be residences. Figure 5-10 shows the locations and Table 5-6 lists these receptors in the study area. Detailed air modelling and impact assessment is discussed in Section 6.5.

Table 5-6: Sensitive Air Receptor Locations

Sensitive Receptor – Air	Approximate Distance from the Port (km)	Direction from the Port
1	1.0	north
2	2.0	west
3	3.0	north-west
4	3.5	south-west
5	4.5	north-west

5.7 Noise

A noise survey of the Project area was undertaken in November 2008. An environmental noise assessment was subsequently completed to model predicted noise levels, which is presented in Appendix G and discussed in Section 6.6. The aim of the baseline noise study was to assess background sound levels at several locations nearby the proposed site to compare with indicative noise levels set by the *Environmental Protection (Noise) Policy 2007* (EPNP). The legislative framework for noise and assessment criteria set by the EPNP, are described in Section 2.1 of Appendix G. Methods used to conduct baseline noise monitoring were completed, with respect to the EPNP and advice provided by the SA EPA.

Sound Level Monitoring (SLM) was undertaken on four monitoring locations, based on accessibility and the proximity to proposed Project activities. Figure 5-10 shows the location and Table 5-7 presents the locations of the receptors relative to the proposed Port.

Table 5-7: Baseline Noise Level Monitoring Locations

Sensitive Receptor – Reference No.	Location	Distance from the Port (km)	Direction from the Port
1	Between 2 farmhouses	2.0	west
2	Farmhouse	1.0	south-west
3	Farmhouse	0.4	west
4	Beach near Lipson	1.0	south

Each SLM station was set to log data every 15 minutes in fast time, weighted for a one week period. The logarithmic average $L_{A90,15 \text{ min}}$ level was calculated from the logarithmic average of all $L_{A90,15 \text{ min}}$ values over the day-time or night-time measurement periods. The SA EPA defines background levels as noise levels that exceed 90% of the measurement period (L_{A90}). Table 5-8 presents the logarithmic average results of sound level monitoring undertaken at the monitoring locations in November 2008.

Table 5-8: 2008 Noise Level Monitoring Results

Sensitive Receptor - Reference No.	Day-time Logarithmic Average ($L_{A90,15 \text{ min}}$) dB(A)	Night-time Average Logarithmic Average ($L_{A90,15 \text{ min}}$) dB(A)
1	38	33
2	44	40
3	54	50
4	55	55

Source: Golder, 2009c

Sound level monitoring at Sites 1 and 2 are considered typical of background sound levels for rural, land-based areas. Sound levels measured at Sites 3 and 4 are considered to be more representative of coastal areas, which reflect their position within approximately 500 m of the coastline.

Environmental factors such as wind and waves can greatly influence sound level measurements. The local wind climate is discussed in Section 5.1 and wind roses presented in Appendix C. During the monitoring period, wind speeds at the Port Lincoln weather station were measured in excess of the EPA threshold of 18 km/h, approximately 70% of the time. No site-specific weather data (including wind speed) was available to confirm the relevance of the Port Lincoln data to the site.

Sound levels measured at Site 1 and Site 2 are considered to be typical of background sound levels for rural, land-based areas. Sound levels measured at Site 3 and Site 4 are considered to be more representative of coastal areas. This reflects their position within approximately 500 m of the coastline. The measured sound levels cannot be considered to represent background sound levels in the context of the EPNP, as the wind speeds being measured in excess of the SA EPA threshold of 18 km/h, approximately 70% of the time during the monitoring period. As the background noise levels for the Port remain uncertain, the default indicative noise levels under the EPNP apply based on land use categories. Noise modelling was therefore undertaken, which is presented in Appendix G and is discussed in Section 6.6.

5.8 Traffic

An assessment was undertaken of the condition of the roads that will be used as access for construction and operation of the Port. The Traffic Assessment report is included as Appendix H and further discussion is provided Section 6.7.

Access to the Project will be via Swaffers Road and Lipson Cove Road, both which are connected to the Lincoln Highway. Lipson Cove Road and Swaffers Road also intersect with Coast Road, which runs parallel to the Lincoln Highway to the west of the Port site.

5.8.1 Lincoln Highway

Lincoln Highway is an arterial road under the care and control of the DPTI⁹. The highway generally follows the east coast of Eyre Peninsula extending from the heart of Port Lincoln and connecting to the Eyre Highway north of Whyalla. In the vicinity of Lipson Cove Road and Swaffers Road, the highway has a sealed width of approximately 10 m, with 3.6 m wide lanes and sealed shoulders. The highway traverses areas of cut and fill along its length. Around the Swaffers Road junction, the highway is in an area of significant fill, with a culvert in place to maintain a natural watercourse which crosses beneath the highway. A 110 km/h speed limit applies to this section of road.

According to 2006 traffic data, traffic volumes along the Lincoln Highway are in the order of 750 vehicles per day (vpd), with approximately 17% commercial vehicle content. Traffic counts undertaken as part of the 2011 traffic assessment indicate there has been some growth on the Lincoln Highway, with traffic volumes of approximately 1,100 vpd being recorded with 22.5% commercial vehicle content. There are no restrictions for Road Trains and B-Double vehicles to use the Lincoln Highway.

5.8.2 Lipson Cove Road

Lipson Cove Road is an unsealed road under the care and control of the District Council of Tumby Bay. The road is constructed within a 20 m wide corridor and extends from a junction with the Lincoln Highway through to Lipson Cove on the coastline, a distance of approximately 7.4 km. The road width is approximately 7 m to 8 m wide, with a number of horizontal curves along the alignment and provides access to a small number of rural properties. Given the road is unsealed, the default rural speed limit of 100 km/h applies to this road.

From 2011 traffic counts undertaken on the Lipson Cove Road, an average of 52 vpd were recorded, with 10% of those being commercial vehicles (refer Appendix H). The road rises towards the Coast Road intersection, where Lipson Cove Road has priority through the give-way controlled intersection. From the intersection, the road falls toward the coast until rising again at the coastline, before turning south toward Lipson Cove and its associated camping ground.

⁹ Formerly known as the Department for Transport, Energy and Infrastructure (DTEI)

5.8.3 Swaffers Road

Swaffers Road is an unsealed road under the care and control of the District Council of Tumby Bay. The road is constructed within a 20 m wide corridor and extends from a junction with the Lincoln Highway through to an intersection with Coast Road, a distance of approximately 2.5 km. The formed road width is approximately 7 m to 8 m wide, with a number of horizontal curves along the alignment, with access to at least two rural properties provided on the northern side of the road. Given that the road is unsealed, the default rural speed limit of 100 km/h applies to this road.

Drivers using Coast Road have priority over Swaffers Road at the intersection, with Swaffers Road under give-way control. On the eastbound approach to the intersection, Swaffers Road rises to the intersection, with an 'advance intersection warning' sign and the give-way sign clearly visible on the approach. The existing sight distance on the northbound approach is not sufficient to meet the Safe Intersection Sight Distance (SISD) requirements as set out in the Austroads '*Guide to Road Design – Part 4A: Unsignalised and Signalized Intersections*' (Austroads, 2009), assuming the 85th percentile approach speed to be 80 km/h and a 6% decline to the intersection. On this basis, SISD for a passenger vehicle on an unsealed surface would need to be in the order of 230 m. The crest in Coast Road is approximately 210 m from the intersection. On the southbound approach, the SISD is achieved. Similarly, on the minor road legs (Swaffers Road approaches) the Approach Sight Distance (ASD) requirements are met.

Swaffers Road extends further east towards the coast where the formed road width narrows and the road provides access to two farming properties. The road is signed as a 'no through road' at the Coast Road intersection and ends at a gated property access.



**SENSITIVE RECEPTOR
LOCATIONS**

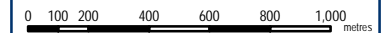


LEGEND

- Air Receptor
- Noise Receptor
- Project Boundary
- Project Layout

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 Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011.



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FIGURE 5-10



5.8.4 Coast Road

Coast Road is an unsealed road under the care and control of the District Council of Tumby Bay. The road is constructed within a 20 m wide corridor and parallels the Lincoln Highway to the east, approximately midway between the coast and the highway, for a distance of approximately 22 km, forming junctions at either end with the Lincoln Highway. As the road is unsealed, the default rural speed limit of 100 km/h applies to this road.

5.8.5 Existing Restricted Access Vehicle Network

The current approved Restricted Access Vehicle (RAV) networks for Road Train and B-Double vehicles are shown in Appendix H. A significant amount of the road network across the Eyre Peninsula can be used by these vehicle classes, including the Lincoln Highway.

5.9 Terrestrial Ecology

A study of the terrestrial flora and fauna associated with the Project area was undertaken in 2008 and is presented in Appendix I. The Port falls within the Waretta Environmental Association, which is characterised as an undulating plain and low hills formed from metasediments with coastal cliffs. The plains area is typically cultivated grassland that is in cereal crop rotation and grazed by livestock, while the hills are typically grazed (Government of South Australia, 2004). The Port is situated within the Eyre Hills (EYB-3) subregion of the Eyre Yorke Block Bioregion. The Eyre Yorke Block Bioregion has been severely impacted due to vegetation clearance for agriculture and pastoral land use (Australian Natural Resource Atlas, 2008). The EYB-3 subregion has 13% vegetation cover and there are no declared reserves, that is, no vegetation is protected within this subregion (DENR, 2012). The site is located within the Hundred of Yaranyacka which in 2002 was estimated to retain only 5.1% of original native vegetation cover (Farmer, *pers. comms*, 2012.). The extent of clearance of native vegetation throughout the Eyre Peninsula increases the importance of the remaining remnant coastal zone cliff top vegetation at the regional conservation level. The Port is within the Southern Eyre Peninsula floristic bioregion of South Australia.

A spring field assessment of terrestrial flora and fauna was conducted at the Project area in 2008. The assessment of flora and fauna followed the standard biological survey of South Australia methodology (DEH, 1997 & 2000). The Biological Survey was registered and the data is available from the Department of Natural Resources, under the survey identifier BS621 Lipson Cove. Vegetation assessment involved the establishment of quadrats (30 m x 30 m) at three locations representative of the vegetation associations present at the Project area (refer Figure 5-11). A walkover survey was conducted of the adjacent cropping land that forms part of the Port and of Rogers Beach that is adjacent to the Port. A roadside day and nocturnal vertebrate fauna survey was undertaken along Swaffers Road between the Port and the junction with Lincoln Highway.

5.9.1 Terrestrial Flora

The majority of the surrounding area is cultivated with remnant native vegetation largely restricted to a narrow strip along the coastal cliffs or within roadside reserves. The surrounding environment is similar to that of the Project area in so much as remnant native vegetation is concentrated along the coastal cliffs. The nearest conservation area to the site is Lipson Island Conservation Park that is approximately 1.5 km to the south. Lipson Island Conservation Park is close enough to the Project area for birds to utilise both areas. There is, however, no vegetation of state or national significance within this Conservation Park. No native vegetation corridors link the Project to the larger conservation areas to the north and north-east. Three distinct remnant plant associations are present at the Port (refer Figure 5-11):

- Low Shrubland
- Tall Open Shrubland, and
- Fallow Paddock.

The extensive area of fallow cropping land inland from the cliff top vegetation is delineated by the coastal cliff top track. Rogers Beach forms a development exclusion area and there would be no expected impacts to Rogers Beach and the associated coastal dunes from the Project. No plant species listed as critically endangered, endangered or vulnerable under the EPBC Act or listed as rare, threatened or vulnerable under the South Australian *National Parks and Wildlife Act 1972* (NPW Act) were located within the Project area. A discussion of the condition of the three distinct plant associations present at site is discussed in the sections below.

VEGETATION SURVEY &
PLANT ASSOCIATIONS
LOCATION PLAN

LEGEND

-  Fallow Previously Tilled Land
-  Low Shrubland / Open Hummock Grassland
-  Sand Dune
-  Tall Open Shrubland - Dillon Bush
-  Tall Open Shrubland - Shore Westringia
-  Wheat - Crop
-  Rocky Outcrop / Stone Pile - Not Tilled
-  Vegetation Survey Location
-  Rogers Beach Port Infrastructure Exclusion Zone
-  Port Spencer Marine Port Site Study Area



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Aerial image sourced from Department for Environment and Heritage, South Australian Government, 2007.
Cadastral data sourced from Centrex Metals Limited, October 2008.

0 25 50 100 150 200 metres

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FIGURE 5-11



5.9.1.1 Low Shrubland

This vegetation association occurs along the coastal strip, refer Photo 1. This was identified as Low Shrubland dominated by *Enchylaena tomentosa* (ruby saltbush) and *Maireana brevifolia* (yanga bush), with an understorey of *Triodia irritans* (porcupine grass), *Lomandra effusa* (scented mat rush), and the weed **Bromus rubens*¹⁰ (red brome grass). Areas of the coastal cliff top vegetation had more prevalent porcupine grass with the shrub overstorey diminished and tended towards being open hummock grassland (EP4703) as had been mapped for the site by DENR (refer Appendix I). The condition of the Low Shrubland vegetation association was 'degraded natural' with eight (57%) weed species present of which seven species are considered to be invasive species with a moderate potential to reduce the diversity of native species (DWLBC, 2005). The Low Shrubland occurs along the coastal cliff top and is of regional importance as it has been considerably reduced in distribution within the EYB-3 IBRA subregion. It is possible that with rehabilitation and effective management of weeds and pest animals that this coastal strip of Low Shrubland could be restored.



Photo 1: Low Shrubland, Site LIP00101

¹⁰ * Indicates that the species is an introduced species.

5.9.1.2 Tall Open Shrubland

Two different Tall Open Shrubland associations occur and the component plant species of each appears determined by the substrates upon which they are found, namely clay or sand. The fore-dune area is occupied by coloniser plant species such as **Cakile maritima* (sea rocket), *Rhagodia candolleana* ssp. *candolleana* (sea berry saltbush), *Spinifex hirsatus* (spinifex), *Zygophyllum apiculatum* (common twinleaf), and *Leucophyta brownii* (cushion bush). Further inland from the beach, in the secondary and tertiary dunes, the Tall Open Shrubland plant association occurs (LIP00201, refer Photos 2 and 3). This is comprised of an overstorey of *Westringia dampieri* (shore westringia) and *Olearia axillaris* (coast daisy bush) over an understorey of the garden escapee, **Argyranthemum frutescens* (Marguerite daisy), **Euphorbia paralias* (sea spurge) and *Isolepis nodosa* (knobby club rush). The presence of **Asphodelus fistulosus* (onion weed) and to a lesser extent **Medicago truncata* (barrel medic) indicates the vegetation condition is disturbed natural.

This vegetation association extends from behind the fore dune to the dirt track that separates the dune field from the fallow paddock. Marguerite daisy is often planted in gardens and may have escaped from such habitat around nearby homesteads.



Photo 2: Tall Open Shrubland, Site LIP00201

* Indicates that the species is an introduced species



Photo 3: Tall Open Shrubland, Site LIP00301

This vegetation association extends from behind the fore dune to the dirt track that separates the dune field from the fallow paddock. Marguerite daisy is often planted in gardens and may have escaped from such habitat around nearby homesteads. The Shore Westringia Tall Shrubland vegetation association located on the headland adjacent Rogers Beach would not be directly impacted by the development as it occurs outside of the development footprint within the development exclusion zone. This vegetation association would benefit from weed control, in particular onion weed and Marguerite daisy and rabbit control to reduce grazing pressure and could be restored to a condition that is close to the original condition. Restricting human access through the dune system would enhance its biodiversity value.

The flat zone located behind the dunes of Rogers Beach comprised Tall Open Shrubland, with an overstorey of Dillon bush, over samphire. The plant species that occur within this area are indicators of severely salt affected ground (Matters and Bozon, 1989). No trees occur in this association. Dillon bush forms large dense clumps that may be comprised of several individual plants and provide cover for rabbit warrens. Salt scalding is evident within large areas of the exposed ground. Additional salt tolerant plants occurring include ruby saltbush, yanga bush, *Wilsonia rotundifolia* (round-leaf wilsonia) and *Mesembryanthemum crystallinum* (ice plant) (an introduced species and coloniser of highly disturbed areas). Apart from grazing pressure exerted by rabbits and soil salinity, the clay pan is also impacted by vehicular traffic. The vegetation present reflects these pressures and is considered to be highly degraded with only five (83%) native species present and ice plant an introduced invasive weed species.

This Dillon Bush Tall Open Shrubland is not considered to be of local or regional importance due to the highly degraded condition and appears to act as a refuge for rabbits and a potential source of weed infestation into the valuable coastal cliff top Low Shrubland and Shore Westringia Tall Shrubland within the dune system. The removal of 2.01 hectares of the Dillon Bush Tall Open Shrubland required for Stage 1 would be offset by the planting of a vegetation corridor along the southern boundary of the site adjacent Lipson Road, refer Section 7.3.1. The remaining Dillon Bush Tall Open Shrubland would benefit from reduction in the rabbit population in part due to the

destruction of warrens in the area to be developed and the active control of these pests that is proposed for the site as part of the ongoing Weed and Pest Management Plan. It is noted that up to 10 nitre bushes may be considered minor clearance for the purposes of rabbit control, subject to approval and when conducted in accordance with the Native Vegetation Council Guideline (2010). It would be proposed that as part of a Weed and Pest Management Plan, approval be sought for the removal of nitre bush for the purposes of rabbit control in the clay pan area of Tall Open Shrubland. The goal of restoring this habitat would be to achieve a vegetation community that was a *Tecticornia spp. Sarcocornia spp.* Low Shrubland.

5.9.1.3 Fallow Paddock

The Fallow Paddock, as shown in Photo 4, has a vegetation cover that comprises weed and colonising species including ice plant, onion weed, **Galenia pubescens* (galenia), **Brassica tournefortii* (Mediterranean wild turnip), and *Salsola tragus* (roly poly). The granite outcrops and stone piles that occur within the paddock supports small populations of yanga bush, *Atriplex semibaccata* (berry creeping saltbush), ruby saltbush, *Triodia irritans* porcupine grass, **Lycium ferocissimum* (African boxthorn), and Scented Mat-rush. There were no intact native vegetation strata occurring within the fallow paddocks at the time of survey, while the remaining area of the site was under wheat cultivation.



Photo 4: Fallow Paddock

5.9.1.4 Weeds and Invasive Species

A total of 19 introduced species, representing 33% of all species identified were recorded within the Project area. A complete plant species list is provided in Appendix I. No Weeds of National Significance (WoNS) were identified as occurring in the Project area or along Swaffers Road. Declared plants (as per the South Australian *Natural Resources Management Act 2004*) known to be present in low numbers within the Project area include:

- African boxthorn
- **Marrubium vulgare* (horehound), and
- onion weed.

The Fallow Paddock area was dominated by environmental weed species (including ice plant) that were also present along Swaffers Road, within the Tall Open Shrubland of the clay pan area and within the coastal Low Shrubland. The garden escape (Marguerite daisy) appears well established within the dune areas, although it did not occur outside of this habitat. Other plants present within the Project area that may be garden escapes include the **Agave americana* (century plant) and **Aloe arborescens* (candelabra aloe) that occurred as isolated plants along Swaffers Road.

The presence of weeds and invasive species within the remnant vegetation associations represented in the Project area indicates that these associations have been degraded. The implementation of the weed and pest management measures has the potential to enhance the biodiversity value of remnant vegetation at the site and within the immediate vicinity.

5.9.1.5 Swaffers Road

The proposed transport corridor between the Project and Lincoln Highway is aligned with Swaffers Road for the majority of its length before being redirected to extend through what was cropped land at the time of the survey. This re-aligned section of the transport corridor was not surveyed for vegetation as the land had been extensively planted with wheat along both sides.

The remainder of Swaffers Road was assessed by a drive-by survey with the location of vegetation mapped as Figures 11a-11e in Appendix I. The list of plant species identified along Swaffers Road is provided in Appendix F of Appendix I. Numerous stands of vegetation have been planted along Swaffers Road and very little remnant vegetation remained. The native vegetation present has degraded by clearing and exotic plant invasion, with no substantially intact strata of native vegetation remaining and generally, agricultural land planted with wheat extended inland from both road verges.

5.9.2 Terrestrial Fauna

The field survey located 26 bird, 7 reptile, 1 frog, 6 mammal and 3 butterfly species at the site (including the Swaffers Road transport corridor). Of these 43 species, none are listed for protection under the South Australian *National Parks and Wildlife Act 1972* (NPW Act) or the Commonwealth EPBC Act, with eight introduced species identified. A complete fauna species list is provided in Appendix I.

* Indicates this species is an introduced species

Typical avifauna (birds) associated with Low Shrubland and Hummock Grassland was similar to that utilising fallow paddocks and cropland, and exemplified by open country species such as *Anthus australis* (Australian pipit), **Alauda arvensis* (Eurasian skylark) and *Ocyphaps lophotes* (crested pigeon). Emergent larger shrubs, such as African boxthorn were used as perching sites for aerial foraging by *Lichenostomus virescens* (singing honeyeater) from the coastal scrub. Tall Shrubland avifauna was dominated by the singing honeyeater, and despite a relatively complex lower stratum in some areas, no fairy-wrens (Maluridae) or acanthizid (Acanthizidae) species were recorded there.

The Low Shrubland and Hummock Grassland herpetofauna (lizards) was more specialised species in common with agricultural land included *Tiliqua rugosa* (shingleback); specialists included *Tympanocryptis lineata* (lined earless dragon) and *Lerista dorsalis* (southern slider). Where outcropping granite occurred in this habitat, the herpetofauna included *Heteronotia binoei* (Bynoe's gecko) and *Lerista bougainvillii* (south-eastern slider). *Morethia adelaidensis* (samphire skink) was common in both Low and Tall Open Shrubland, and *Tiliqua occipitalis* (western Blue-tongued lizard) was only encountered in linear remnants surrounded by cropland. The identification of *Morethia adelaidensis* (samphire skink)¹¹ (Kovach pers. comms. 2008). A single *Neobatrachus pictus* (mallee spadefoot toad) was captured in Tall Shrubland.

Apart from one *Macropus robustus* (euro) flushed from Tall Shrubland at LIP-001 (and evidenced by numerous tracks in the area), no other native mammals were observed in the study area. Introduced pests were recorded including *Oryctolagus cuniculus* (rabbit), *Mus musculus* (house mouse), *Felis catus* (cat) and *Vulpes vulpes* (fox) were recorded.

Incidental records of fauna were collected from a drive-by survey along Swaffers Road. Regular stops were made where remnant native vegetation species or plantation trees occurred. No significant fauna habitat occurred along this road. Generally, agricultural land planted with wheat extended inland from both road verges, except for small isolated patches of trees and shrubs.

Derelict babbler nests were observed in remnant and planted trees on Swaffers Road (and Lipson Cove Road), but no live babblers were observed or heard anywhere in the study area or immediately adjacent. Based on the distribution of extant babbler populations on the Eyre Peninsula, these nests are likely to have been made by *Pomatostomus superciliosus* (white-browed babblers). Their apparent local extinction reflects the generally simplified avifauna of this road corridor, where no woodland/mallee specialist species persist. All of the birds present are characteristic generalists of the farmland landscapes of the Eyre Peninsula.

Two fauna species, *Haliaeetus leucogaster* (white-bellied sea-eagle) and *Tursiops aduncus* (Indo-Pacific bottlenosed dolphin) (listed under the EPBC Act as marine migratory and cetacean, respectively) were located on or immediately adjacent to the Project area. Ten fauna species listed under the appropriate Schedules (7, 8 and 9) of the South Australian *NPW Act* were observed, or were regarded as at least moderately likely to regularly occur in the vicinity of the Project area (refer Appendix I). The study area does not contain habitat that is critical or limiting (in the sense of the EPBC Act guidelines on significance) for any of the listed fauna species.

¹¹ This species was incorrectly identified in Appendix I as *Morethia boulengeri* (south-eastern morethia skink)

5.10 Lipson Island Ecology

Section 5.3.1 of the Guidelines (DAC, 2011) require Centrex to investigate the potential effect of the development on the Lipson Island Conservation Park, which is located approximately 1 km south of the closest Project boundary, and approximately 1.5 km from the jetty. Lipson Island is a designated Conservation Park under the NPW Act and in its simplest terms is a significant bird rookery and roost for species including those listed under the NPW Act and the EPBC Act. The intertidal environment, although not significantly abundant, has no recorded invasive species.

In 2011 a baseline ecology study was undertaken on the island and the full report is presented in Appendix I. The objective of the study was to characterise the existing flora and fauna species and habitat types of the Port's potential area of impact, with particular focus on species and communities of conservation significance (local, regional, state or national). This Section summarises the results of the survey.

5.10.1 Flora Ecology

5.10.1.1 Terrestrial

Lipson Island is a low-lying intertidal island with extensive areas of bare rock (80%) and sand (10%), with the remaining vegetation dominated by *Nitraria billardierei* (nitre bush). Nitre bush is a perennial salt-tolerant shrub commonly found in saline and coastal areas. Only four other terrestrial flora species were observed on the island (refer Appendix I). Low terrestrial flora inventory is typical of low-lying islands particularly if populated by large numbers of nesting and roosting seabirds.

5.10.1.2 Intertidal

Intertidal flora was conspicuously absent, with the only presence being disturbance-resistance surface films, for example, seagrass, *Hormosira banksii* (Neptune's necklace), kelp and filamentous algae. This may reflect storm conditions that occurred in the weeks before the survey was undertaken.

5.10.2 Fauna Ecology

5.10.2.1 Terrestrial

The transect surveys on Lipson Island discovered 87 active bird nesting burrows indicating that the island is a nesting site for *Eudyptula minor* (little penguin) and possibly other burrow-nesting seabirds. Acoustic monitoring recorded the little penguin clearly vocal at night and the frequency of calls suggests that more than 26 little penguins (those observed) return to the island to roost and raise young at night.

The little penguin is listed as a marine species under the EPBC Act. The species is not listed in the NPW Act. The species is in significant decline in South Australia, although no long-term empirical study exists in the state. The prime causes of decline are currently unknown, and the species on Lipson Island is also likely in decline. The observations of large numbers of birds in breeding colonies of *Phalacrocorax fuscescens* (black-faced cormorant) and *P. varius* (pied cormorant) on the northern point of Lipson Island indicates that the island is a habitat for local breeding and roosting seabirds. Other birds that may also breed on the island, but were not identified during the survey, include *Sterna nereis* (fairy tern), *S. fuscata* (sooty tern), *S. bergii* (crested tern) and *Puffinus tenuirostris* (short-tailed shearwater). Other seabird and little penguin rookeries within the Spencer Gulf are likely to be on Tumby Island (approximately 20 km south) and Sir Joseph Banks Group of Islands (approximately 22 km south).

Infrared cameras showed Lipson Island to be a nocturnal roosting site for the local populations of pied and black-faced cormorants, *Larus novaehollandiae* (silver gull), *Columba livia* (rock pigeon), *Sturnus vulgaris* (common starling) and crested tern. During summer months fairy tern and the migratory waders, namely *Calidris ruficollis* (red-necked stint), *Pluvialis squatarola* (grey plover) and *Calidris alba* (sanderling), although not observed (due to timing of the field surveys) or recorded in desktop surveys, may also roost on the island, though the likely number that may roost there is not known. These species are listed as marine migratory species under the EPBC Act.

On rare occasions *Haliaeetus leucogaster* (white-bellied sea-eagle) and *Pandion cristatus* (eastern osprey) may feed on birds that breed and roost on Lipson Island. The white-bellied sea-eagle and eastern osprey are both listed as marine migratory species under the EPBC Act. The white-bellied sea-eagle is also listed as endangered under the NPW Act.

In warmer months it would be expected the bats would feed on insects that associate with guano (bird droppings) prevalence. No terrestrial mammals are expected to inhabit the island. The lack of recorded reptiles probably reflects the cooler conditions and some reptiles would likely be observed in the warmer months.

5.10.2.2 Intertidal

The characterisation of the intertidal habitat of Lipson Island revealed a reasonably high diversity of intertidal biota. Groups such as gastropod snails, limpets and crustaceans were well represented. However other groups were conspicuously absent including urchins, seastars and small rock pool fishes such as blennies and gobies. The high wave action around the island and steep shores with few permanent rock pool refuges is likely to naturally limit available habitat for species that prefer more sheltered conditions. The role of a large storm event in the days prior to the survey and cool weather in displacing biota and limiting site records is unknown, but cannot be ruled out given moderate amounts of shore debris noted.

Changes in richness and abundance were observed across the intertidal range, with greatest abundance and richness of biota being present in the low tide margins (that emerged from the water for the shortest duration during the tidal cycle). These changes in richness and abundance through the intertidal range are likely to reflect the ecological specialisations of each of the animals (for example resource use, competition, feeding behaviour, and physiological adaptations). In addition, changes in richness and abundance were evident between habitat types, for example, the more exposed and steep coastline on the south of the island had lower and different species richness by comparison to the sandy habitat and tide pool.

Syngnathids, *Filicampus tigris* (tiger pipefish) and *Phycodurus eques* (leafy seadragon), both of which are listed as marine species under the EPBC Act, may be expected to occur locally in subtidal habitats, along with other marine fishes and invertebrates of state conservation concern (Gowlett-Holmes, 2008 and Baker, 2009). The use of the intertidal habitat by species of recreational importance was detected (i.e. *Aldrichetta forsteri* (yelloweye mullet) and *Platycephalus caeruleopunctatus* (bluespot flathead)), however this habitat is unlikely to be of significance in the species ecology.

5.10.3 Introduced Species

One South Australian declared weed species was recorded during the Lipson Island survey: African boxthorn. Two introduced fauna species, *Sturnus vulgaris* (common starling) and Rock pigeon, were recorded on Lipson Island. No introduced marine flora or fauna was found in the intertidal survey.

5.11 Marine Ecology

This Section provides a description of the biological surveys undertaken to describe the marine environment in the vicinity of Port Spencer and briefly describe the marine flora and fauna recorded in each of the habitats surveyed in the vicinity of the Project (refer Figure 5-12). Three surveys have been undertaken of the marine environment in the vicinity of the Port: October 2008, July 2010 and August/September 2011. These surveys were used to develop an understanding of the marine communities present.

The 2008 survey (Golder, 2009b), involved a preliminary review and assessment of the potential environmental impacts associated with the Port development. The review included an assessment of existing information regarding the marine environment (including physical characteristics, habitats and biological communities) in Spencer Gulf and a preliminary field survey to assess site conditions. This preliminary survey involved a high level assessment of intertidal and subtidal habitats, sampling of epibenthic, infauna and zooplankton assemblages, as well as sediment and water quality sampling and analysis.

The 2010 marine ecological assessment (Golder, 2011c) aimed to provide more detailed site-specific information on key habitats within the direct footprint of the proposed jetty, and in turn update (where appropriate), the assessment of potential environmental impacts. This assessment incorporated the concept design for the jetty to better reflect the potential for Port impacts.

In 2011, further targeted quantitative surveys were also undertaken (refer Appendix K) to quantify the marine species at the site. The findings of these surveys were used to better understand the potential impacts from the construction and operation phases.

These studies identified the following marine habitats in the vicinity of the Project site:

- Intertidal Communities
- Rocky shores
- Sandy beaches/bays
- Subtidal Communities
- Rocky reef

- Seagrass meadows/sandy substrate, and
- Sandy substrates.

The ecological characteristics of each of the above ecosystems are summarised in the following sections.

5.11.1 Intertidal Communities

The intertidal habitats in the vicinity of the Port include small rocky headlands which lie between intertidal sandy beaches to the north and south. The intertidal communities of rocky shores and sandy beaches at the Port are discussed below. A detailed description is provided in Appendix K.

617,000

618,000

6,210,000

6,209,000



POTENTIAL IMPACT ZONE

617,000

618,000

6,210,000

6,209,000

PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

PORT SPENCER
MARINE HABITATS



LEGEND

- Intertidal Sandy Beach / Bays
- Intertidal Rocky Shore
- Reef / Macroalgae
- Sand (sparse cover of *Heterozostera nigricaulis* and *Halophila australis* in the shallower extent of the defined area)
- Seagrass (*Amphibolis antarctica*, *Posidonia sinuosa* and *P. angustifolia*)
- Seagrass (*Posidonia sinuosa* and *P. angustifolia*)

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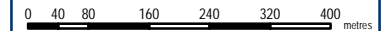


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Aerial image sourced from Bing Maps, date sourced 28.11.2011.

Township data sourced from MapInfo Street Pro.

Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011.



SCALE (AT A4) 1:10,000

DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 5-12



5.11.1.1 Rocky Shores

Intertidal rocky shores occur on the Project area headlands. In 2011 the marine ecological survey (refer Appendix K) recorded 23 faunal taxa and 15 algal taxa. Molluscs (gastropods, limpets and false limpets) dominated the mid-shore areas. The most commonly recorded invertebrates were *Austrocochlea* spp., *Austrolittorina unifasciata* (blue periwinkle), *Bembicium* spp., *Cellana tramoserica* (variegated limpet), *Nerita atramentosa* (black nerite), *Patelloida latistrigata* and *P. alticostata* (crescent moon limpet), *Patella chapmani* (Chapmans limpet), *Siphonaria diemenensis* (Van diemen's false limpet) and *S. zelandica*, *Notoacmea* spp. and *Plaxiphora albida*. Barnacles such as *Catomerus polymerus* and *Chamaesipho tasmanica* (honeycomb barnacle) were also present.

The species recorded during the surveys are considered typical of species found on South Australian (SA) intertidal rocky shores on moderately exposed coastlines (and more broadly along the warm to cool temperate shores in the Flindersian Province of Australia) (Edgar, 2008 and Gowlett-Holmes, 2008).

There were no listed endangered, threatened or rare species noted during the surveys.

5.11.1.2 Sandy Beaches

The Project area intertidal sandy beaches are categorised as intermediate/low tide terrace, in morphodynamic type (Short, 2001) and are considered common around the SA coastline. In 2008 a qualitative survey of the intertidal sandy beaches at the Port was undertaken (Golder, 2009b). The sandy beaches were described as sandy shores interspersed with rocky outcrops and fringed by pebbles, cobbles and boulder habitat. Larger boulders or cobbles occurred higher on the shore within the supratidal zone, with a gradual decrease to pebbles and then sand moving down-shore. The presence of amphipods beneath rocks was noted.

A noticeable feature of sandy beach habitats was the presence of isolated outcrops of granite, basalt and other boulders in intertidal areas. A range of rocky shore fauna were found growing on these outcrops including blue periwinkle, black nerite, *Catomerus polymerus* and *Chamaesipho tasmanica* as well as dense beds of the mussel *Xenostrobus pulex* (little black horse mussel). *Ozium truncates* (black finger crab) was also observed in crevices of these rocky outcrops. Algal species were similar to those found in rock pools and low-tide areas of the main rocky shore areas.

No significant intertidal shellfish beds, marine mammal haul out sites or seabird habitats were noted during intertidal investigations. There were no listed endangered, threatened or rare species noted during the surveys.

5.11.2 Subtidal Communities

The subtidal communities in vicinity of the Port included rocky reefs, seagrass and sandy substrate habitats. The following outlines the key subtidal habitats present at the Port. There were no endangered or threatened species listed under the NPW Act or EPBC Act noted during the surveys. A detailed description is provided in Appendix K.

5.11.2.1 Rocky Reefs

The shallow subtidal rocky reefs at the Port site are restricted to the areas which form an extension of the rocky shore headlands. These areas are dominated by macroalgae species inhabiting a low to medium profile reef system made up of a complex of medium to large boulders, vertical slabs, broken horizontal platforms and crevices. This habitat type occurs from 0 m to 7 m below sea level (BSL) at the Port. During the 2011 survey (refer Appendix K) the following were recorded:

- Twenty-five macroalgal and sessile invertebrate taxa, which included the following:
 - 10 canopy-forming species (*Ecklonia radiata* (leather kelp), 5 species of Cystophora, 3 species/subgenera of Sargassum, and small quantities of *Scaberia agardhii* and *Caulocystis cephalornithos*)
 - Understorey brown algal species (mainly *Lobophora variegata* (black fan plant) and *Zonaria spiralis*, with a small patch of *Dictyota* sp.)
 - Articulated coralline algae (Metagoniolithon, Amphiroa, Haliptilon and small patches of Jania)
 - Various turfing algae and crustose coralline algae, and
 - Sessile invertebrate groups (sponges, bryozoans and ascidians).
- Thirty-five species of mobile invertebrates and cryptic fish:
 - The number of individuals varied from approximately 50 to 450 (total more than 1,000), and was strongly influenced by the abundance of the gastropod *Turbo undulates* (common warrener), the crinoids *Comanthus trichoptera* and *C. tasmaniae*, the asteroid *Meridiastra gunnii*, and the *Heliocidaris erythrogramma* (purple urchin). Cryptic fish included the *Trinorfolkia clarkei* (common threefin) and *T. Cristatus* (crested threefin), *Heteroclinus tristis* (weedfish) and another undifferentiated weedfish species were recorded.
- Fifteen species of demersal fish, with a total of 288 individuals recorded:
 - *Notolabrus tetricus* (blue throated wrasse) and *Siphonognathus beddomei* (pencil weed whiting) were observed the most frequently, and the blue throated wrasse and *Scorpiis aequipinnis* (sea sweep) were the most abundant.

The composition of species in the shallow reef zone at the Port is typical of that described for temperate Australian subtidal reefs, which are characterised by the structural dominance and diversity of large macroalgae and an abundance of sessile and mobile invertebrate assemblages (Edyvane, 1999a and Underwood & Chapman, 1995).

5.11.2.2 Seagrasses

The seagrass beds at the site were dominated by *Posidonia angustifolia/sinuosa* (tapeweed) and *Amphibolis antarctica* (wireweed). Between approximately 7 m to 10 m BSL, mixed beds of wireweed, *Posidonia angustifolia*, and *P. sinuosa* were found. Between 10 m to 15 m BSL, wireweed ceased to be present, and *P. angustifolia*, and *P. sinuosa* were found. Sparse, patchy cover of *Heterozostera nigricaulis* and *Halophila australis* were also reported to a depth of 16 m BSL.

A total of 32 mobile invertebrate and cryptic fish taxa were identified and 1,766 specimens counted. The most abundant taxa were *Meridiastra gunnii* (six-armed star), the razorfish, and to a lesser extent, the *Goniocidaris tubaria* (pencil urchin). Other species encountered include the greenlip abalone, *Phlyctenactis tuberculosa* (swimming anemone) and *Phasianella australis* (pheasant shell). Very few species or individuals of demersal fish were sighted during fish surveys, with *Siphonognathus beddomei* (pencil weed whiting) and *Haletta semifasciata* (blue weed whiting) being the only two species reported.

The seagrass meadows in the Project area are considered to be typical of assemblages found in shallow, moderately-exposed locations across much of South Australia. For a more comprehensive discussion regarding the seagrass habitat and assemblages, refer to Appendix K.

5.11.2.3 Benthic Macro-Infauna

Systematic subtidal studies of benthic macro-infauna assemblages in Spencer Gulf are most prevalent for the northern or upper gulf region, but only a limited number of studies have been carried out in the central and southern region of Spencer Gulf (Shepherd, 1983; Ainslie et al., 1989; Hutchings et al., 1993; Ainslie et al., 1994).

Assessment of the benthic macro-infauna assemblages was undertaken during 2008 and 2011 surveys. During the most recent study, the total number of individuals varied considerably between sites (21 to 536 individuals for seagrass samples and 49 to 75 individuals in the sandy mid-benthic habitat).

Samples from the seagrass habitat were dominated by the presence of crustaceans (i.e. amphipods, isopods and crabs), followed by annelids (worms), and to a lesser extent molluscs (i.e. bivalves and gastropods (marine snails)). Annelids (worms) dominated the fauna for all of the sandy mid benthic sites. The differences between the types of fauna reported for the seagrass and mid benthic sandy habitats is considered likely to be due to differences in the above and below ground biomass provided by the presence of seagrass shoots and rhizomes. These results are consistent with the previous macro-infauna survey undertaken at the Port in 2008.

5.11.2.4 Zooplankton

Zooplankton are small, microscopic animals which are either permanently (holoplankton) or temporarily (meroplankton) part of the plankton. At the Port, zooplankton were collected from the water column above algal and seagrass beds. Copepods and mollusc larvae (gastropods and bivalves) were present in the zooplankton samples. Other zooplankton encountered included arrow-worms (Chaetognatha), fish larvae (Actinopterygii), decapod larvae (crayfish, crabs, prawns and shrimps), krill (Euphausiacea) and sealice (isopods).

5.11.3 Rare and/or Threatened Species and Communities

Cryptocnemus vincentianus (leucosiid crab) was identified as occurring at the Port. One specimen was found in the seagrass habitat in the vicinity of the proposed jetty. The occurrence of this specimen is notable as it is the only species in the family Cryptocnemus (of the five which occur in Australian waters) which is known to occur in southern Australia waters, and its documented presence in South Australia is based on a single specimen found in 1927 (Poore, 2004). This specimen was recorded from dredged material off Semaphore (Davie, 2002) in Gulf St. Vincent. In addition to the Gulf St. Vincent specimen, this species has been reported from subtidal rocky reef samples collected in Western Australia (Keesing, 2006).

During the survey of the rocky reefs a male/female pair of the crested threefin (which is endemic to South Australia), was recorded at the Port. This species has been recorded at a number of locations between Ceduna and Victor Harbor. Although Edgar (2008) described this species as rare, Baker (2009) noted that it has been commonly recorded, and appears not to be rare within its known range. The species is not listed under the NPW Act or EPBC Act.

5.11.4 Marine Pests

The Asian mussel, *Musculista senhousia*, was found in seagrass samples collected at the Port site. The Asian mussel is a member of the Mytilidae family and is native to the Pacific Ocean. It is an invasive species in California, the Mediterranean, Australia, and New Zealand (NIMPIS, 2009). The majority of individuals were found in samples collected in seagrass beds in the vicinity of the proposed jetty. There were no individuals recorded in the sandy sediment samples collected further offshore.

Although present elsewhere in South Australia, no records were found which indicated the Asian mussel has previously been reported in Spencer Gulf. Subsequent discussions with Biosecurity SA have confirmed that the presence of the Asian mussel at the Port is an extension of the pest's known distribution in South Australia (Sierp, *pers.comms*, 2011).

5.11.5 Fisheries

There are a range of commercial and recreational fisheries in Spencer Gulf, including shellfish, finfish and crustacean fisheries. One of Australia's largest prawn fisheries occurs in the gulf, based on the western king prawn. Prawn trawling occurs throughout the gulf to the south of Lowly Point and Ward Spit, and the major trawl areas include the northern area from Whyalla to Wallaroo, Wallaroo (which is the largest trawl ground in the gulf), a deep channel known as the gutter, Cowell and the western gutter. Major home ports for the trawl boats are Port Lincoln, Wallaroo, Port Adelaide and Port Pirie. The *Portunus pelagicus* (blue swimmer crab) and *Jasus edwardsii* (southern rock lobster) are other crustacean species also commercially fished in Spencer Gulf. The major targeted species of finfish include *Sillaginodes punctata* (King George whiting), *Hemiramphidae* spp. (garfish) and *Pagrus auratus* (snapper) (DEH, 2003).

Recreational fishing is also a popular activity in some regions of Spencer Gulf. The most commonly caught species include King George whiting, garfish, blue swimmer crabs and *Arripis geogianus* (tommy ruff). Commercial fishing for giant cuttlefish began in 1997, with the main fishing activity occurring near the spawning ground at Black and Lowly Points (DEH, 2003).

Haliotis rubra (blacklip abalone) and greenlip abalone are also taken as a fisheries resource in Spencer Gulf. Blacklip abalone are taken from waters along the coastal headland areas of rocky reef to 12 m depths, while Greenlip abalone are taken from depths greater than 5 m along Tiparra Reef, Hardwicke Bay and in proximity to Franklin Harbour (DEH, 2003). Fishing for abalone occurs from Port Lincoln to Cowell, at Port Victoria, Wardang Island, Corney Point, Tiparra Reef, Hardwicke Bay and Cape Elizabeth. Greenlip abalone stocks are reported to be in decline at Hardwick Bay; although the catch is thought to be increasing at Tiparra Reef and Cape Elizabeth.

There are several aquaculture enterprises including those at Port Augusta (yellowtail kingfish), Arno Bay (yellowtail kingfish, snapper and mulloway) and Cowell (oysters).

5.11.5.1 Recreationally and Commercially-Significant Species

Regulated commercial and recreational fishing species recorded during the surveys of the rocky reefs included the *Haliotis laevis* (greenlip abalone) (three individuals below legal size), *Pinna bicolor* (razorfish) (one individual) and sea sweep (65 individuals). A further species taken recreationally and commercially is the blue throated wrasse (120 individuals recorded).

Commercially and recreationally important species recorded during seagrass surveys included razorfish (745 individuals) and the greenlip abalone (12 individuals). However, the razorfish were located in a depth that is not usually fished, i.e., they are normally harvested from intertidal areas.

5.11.6 Marine Reptiles

There is limited information on the marine reptiles of Spencer Gulf, however there have been occasional reports of migratory turtles such as the Hawksbill turtle (*Eretmochelys imbricata*) passing through the area. The Green turtle (*Chelonia mydas*) and Loggerhead turtle (*Caretta caretta*) have also been noted in the gulf (DEH, 2003). These species are not expected to be part of the Port site dependant fauna.

5.11.7 Marine Mammals

A total of 31 species of marine mammal have been recorded in South Australian waters, and pinnipeds, whales, and dolphins comprise the dominant marine mammal fauna in Spencer Gulf (Edyvane, 1999a).

Twenty-three major breeding colonies for the endemic *Neophoca cinerea* (Australian sea lion) are found in western South Australia, with the three largest colonies recorded from The Pages, Dangerous Reef and Seal Bay on Kangaroo Island. The Australian sea lion is Australia's only endemic sea lion with over 80% of the population found in South Australia.

A few colonies of the *Arctocephalus forsteri* (New Zealand fur seal) are also found in Australia. These seals are generally found on the islands in the entrance to Spencer Gulf and on Kangaroo Island. In the gulf, the largest breeding populations of New Zealand fur seals have been recorded on the Neptune Islands with around 61% of the South Australian population utilising this area. The islands of the Sir Joseph Banks Group also have smaller but, nonetheless, important colonies of fur seals and sea lions, and breeding occurs at some of these sites. These pinnipeds display considerable mobility between haul out sites (Edyvane, 1999a).

Eubalaena australis (southern right whales) may mate and calve in Spencer Gulf and a range of other whale species have been recorded as occasional visitors to the region (DEH 2003). *Orcinus orca* (killer whales), in particular, are thought to visit the coast along Eyre Peninsula due to the abundance of pinnipeds. In general, the high concentration of marine mammals in the gulf is attributed to the upwellings in the region, which are linked to the abundant pilchard populations that these marine predators feed on (Edyvane, 1999a).

Included among the 17 species of cetaceans recorded in South Australia are *Tursiops truncatus* and *T. aduncus* (bottlenose dolphins) and *Delphinus delphis* (short-beaked common dolphins), which are known to breed in Spencer Gulf (DEH, 2003). The dolphins are most common in December and May and less so in November and March, and a high abundance of individuals is typically noted further north close to Whyalla. These dolphins are, however, probably not geographically limited as they have a range of approximately 1,340 km and both species have cosmopolitan distributions (Svane, 2005; Edyvane, 1999a).

The Port site is not considered a significant breeding habitat or site for marine mammals.

5.12 Coastal Environment and Wave Dynamics

Studies have been undertaken to understand the current coastal environment and wave dynamics, and a sediment transport assessment undertaken to review potential impacts of jetty construction, refer Appendix J and K.

5.12.1 Physical Environment and Bathymetric Characteristics

Spencer Gulf is the westernmost of two large inlets on the southern coast of South Australia (the other being the Gulf St Vincent). The gulf is a semi-enclosed body of water that is bordered by the Yorke Peninsula on the eastern coast and Eyre Peninsula to the west, and extends for approximately 300 km from the entrance to the northern reaches near Port Augusta. The narrow entrance that opens into the Southern Ocean is approximately 79 km wide and is further constricted by several small islands. Spencer Gulf has a maximum width of approximately 130 km, while the narrowest region in the vicinity of Port Augusta, is less than one kilometre wide (DEH, 2003; Noye, 1984).

Spencer Gulf is a relatively shallow embayment with an average depth of approximately 20 m (Nunes & Lennon, 1987). Maximum depths are in the order of 40 to 60 m in the middle and southern regions and near the mouth of the gulf. The northern Spencer Gulf is shallower where depths in the main northern channel are 15 m to 20 m decreasing to approximately 7 m in the upper reaches past Lowly Point, with an average depth of approximately 13 m (Nunes & Lennon; 1986; Shepherd & Hails; 1984).

The middle and southern regions of the gulf include two main channels of an average depth of 40 m (DEH, 2003). From 40 m depths at the mouth, the seafloor slopes down towards the south-east onto the shelf at a gradient of about 1 in 1,000 (Bowers & Lennon, 1987; Bye & Whitehead, 1975).

The seafloor is generally smooth, although scouring of unconsolidated sediment has been noted in the vicinity of Lowly Point and the estuarine environments of Douglas Point. Some areas are overlain by predominantly calcareous sandy substrates that can form megaripples of 1.3 m in height and 2 m to 20 m in wavelength. The predominant seafloor substrates in Spencer Gulf are characteristic of cool-water, high-salinity carbonate sedimentation. These include tidal mudflats and sandy seafloors with megaripple beds and some rocky outcrops and reefs (Burne & Colwell, 1982; Edyvane, 1999b).

5.12.2 Oceanographic Characteristics

There are several major types of oceanographic processes driving water movement in Spencer Gulf and between gulf waters and the Southern Ocean (DEH, 2003). These include thermohaline currents, tidal streams, water movement associated with long-period sea level oscillations (i.e. swell), wind-driven currents, and residual currents. Thermohaline or density currents and tidal currents are the more sustained current flows within Spencer Gulf (Bullock, 1975). Water exchange between the upper and lower regions of the Spencer Gulf is, however, limited as the upper gulf is much shallower than the lower gulf and water movement is constricted at Ward Spit during low tides (Noye, 1984).

5.12.2.1 Spencer Gulf Tides and Tidal Currents

One of the characteristic features of tidal movement in Spencer Gulf are the neap tides, which are known locally as 'dodge tides' because virtually all tidal movements cease for a period of approximately 24 hours at 14-day intervals. During other times the tidal variation is generally in the order of 2 m. Thus, in the absence of storm conditions, tide heights vary from a large vertical amplitude at spring tide, associated with large tidal streams and considerable tidal mixing, to practically no tidal variation at neap tide.

Long period tides include annual solar, semi-annual lunar, monthly and fortnightly cycles and are mainly due to meteorological effects such as seasonal variations in barometric pressure, wind speed and direction, salinity and temperature. Observations undertaken in the 1980s show a regional change of 0.17 m in sea levels with the maximum occurring in the period April to August and the minimum in January to March (Noye, 1984).

In general, the mechanism responsible for the homogeneity of water columns within Spencer Gulf is based on vertical mixing promoted by tidal currents, which are amplified by the shallow water running over a rough bottom, thus enhancing vertical diffusion by the shear effect (Bullock, 1975). Tidal currents near the mouth are also important for the flushing of the gulf and, as the semidiurnal currents are small, the exchange of water with the ocean is mostly due to the diurnal tidal constituents (Easton, 1978).

5.12.2.2 Spencer Gulf Thermohaline Currents

Thermohaline currents are brought about by horizontal pressure gradients resulting from density variations in the waters of Spencer Gulf. Density variations are caused by the temperature and salinity differences that result from variations in the effect of evaporation over the region.

The gulf waters become highly saline during summer owing to considerable evaporation, which results from the wide seasonal temperature fluctuations and low fresh water inflow to the northern gulf (Edyvane, 1999b). Winter surface temperatures decrease from 15°C at the mouth to about 12°C at the head, while summer surface temperatures increase from 19°C near the mouth to nearly 30°C at the head. The average annual rainfall can vary from 240 mm at Point Augusta to 340 mm at Port Pirie, while the average annual evaporation is of the order of 2,250 mm in this region. As a consequence, salinity at the head of the gulf can reach maximums of 40-50‰ by the end of the summer season (Bowers & Lennon, 1987; Nunes & Lennon, 1986; Noye, 1984). A maximum longitudinal density gradient then occurs in the autumn and winter when the saline water at the head is cooled. When the high salinity water cools, it moves to the seafloor and flows out of the gulf while less saline and, therefore, less dense water flows inwards along the surface from the shelf into the gulf (Alendal et al., 1994).

This density current represents a major exchange mechanism that releases salt from the gulf, and it is the winter season that appears to be a critical time for this water exchange. Thus, the southern basin may act as a reservoir for high-density fluid through the warmer months of the year, finally discharging its accumulated load to the shelf in early winter. As the waters at the head of the gulf are more saline than those occurring at the mouth, which is a situation that is usually reversed in typical estuarine systems, the region has been described as a negative or inverse estuary. The inverse estuary regime is not unique to the South Australian gulfs, and is found in the Red Sea, the Persian Gulf and the Mediterranean (Nunes & Lennon, 1986).

Differences in salinity also occur latitudinally across the gulf with salinity increasing from west to east (Bullock, 1975; Edyvane, 1999b). In both the surface and bottom waters there is a very distinctive flow up the western side of the gulf (Noye, 1984), which is referred to by Bullock (1975) as the Port Lincoln Boundary Current (PLBC). This current is broader in extent at the surface than at the bottom and is also somewhat stronger at the surface due to the frictional influence of the bottom current. The bottom current eventually moves eastwards and then to the southeast over a broad area before flowing southward through the mouth of the gulf. The surface current follows a similar path; however, as the PLBC is wider at the surface, particularly near the mouth, the centre of the gyre of the surface circulation is located further to the north-east than the centre of the bottom gyre. Thus, the movement of water within the middle to lower Spencer Gulf is essentially clockwise. This advective exchange with the water outside the gulf is limited to the area below the latitude of about 33°45'S.

5.12.2.3 Spencer Gulf Residual Currents

Residual currents also occur within Spencer Gulf waters, which appear to be independent of meteorological conditions. At high latitudes residual currents may be attributed to interplay of the Coriolis forces and non-linear tidal stresses. In the South Australian gulfs, the Coriolis Effect is however small. Nevertheless, the residual currents are large with velocities up to 0.25 m/s recorded in the gulf. The gulf, especially the upper region, is long and narrow the tidal trajectory is also long and the current velocities are correspondingly large. The western shore of the upper gulf below Blanche Harbour (32°43'S) and the eastern shore above Yatala Harbour (32°46'S) are also marked with a series of headlands that constrict the tidal flow and serve to divide the gulf into a series of cells. General hydrodynamic theory predicts that large eddies or vortices will form downstream from such headlands in the upper gulf, eddies occur to the north of headlands during the incoming tide and to the south of these points during the outgoing tide (Green, 1984). Notable changes in salinity have also been observed near headlands, such as Redcliff Point, which further indicate the existence of distinct cells of residual current circulation to the north and south of major headlands.

Currents in the Vicinity of the Port

Between October 2009 and March 2010, measurements were undertaken to record current speeds at the Project area. Overall the maximum current speeds were between 0.34 m/s and 0.69 m/s, with larger current speeds observed at the top of the water column. Mean current speeds were 0.14 m/s at the top of the water column and 0.10 m/s and 0.09 m/s for the middle and bottom of the water column, respectively.

Swell and Wind Waves

Wave energy in Spencer Gulf ranges from moderate at the mouth of the gulf to very low in the upper regions. Overall, the gulf is a very sheltered ecosystem, subject to very low to low wave energy regimes (Edyvane, 1999b). The dominant currents in upper Spencer Gulf are tidal currents, which normally generate turbulent mixing (Bye, 1981). Wave heights were typically less than 1.0 m, but waves of up to 1.8 m were recorded.

The wave climate of Lipson Cove (as opposed to ocean wave, refer Section 5.1) was assessed as part of feasibility studies for the Project. The Port location is largely protected from the strong swells that propagate from the Southern Ocean. Some swell waves do penetrate through the islands and headlands at the entrance to the gulf, with a medium swell height of 0.1 m. The largest waves occurring at the Port are generated by winds from the south-east, with the largest wave height calculated at 3.6 m (from a six year dataset). The majority of waves at the Project arrive from the east-south-east through to south-south-east and have an average peak wave period of 4.5 seconds. Refer to Appendix J for further information on the wave climate of the Port.

5.12.3 Temperature and Salinity

5.12.3.1 Temperature

This region of South Australia experiences a Mediterranean climate, with warm temperate weather conditions (DEH, 2003). Semi-arid to arid terrain surrounds the gulf, where annual rainfall is less than

350 mm and there is little freshwater runoff into coastal waters. As a consequence, evaporation in Spencer Gulf is high during the summer months. High evaporation combined with limited water exchange between gulf waters and the open ocean results in a negative salinity gradient into the upper reaches of the inlet, hence Spencer Gulf has been described as an 'inverse estuary' (Svane, 2005; DEH 2003).

Air and water temperature records from 1982, 1984 and 1985 show that seasonal water temperatures follow air temperatures, and that the ambient average monthly water temperatures range from 10°C to 12.5°C in winter to 24°C to 28°C in summer. Annual temperature changes are large due to the shallowness and low heat storage capacity of Spencer Gulf; however, temperature is relatively uniform at any one time of the year because of intense horizontal mixing. During late summer and mid to late winter there are large temperature gradients between the northern gulf and the shelf (Nunes & Lennon, 1986 and 1987).

5.12.3.2 Salinity

Practical Salinity Units (psu) measure the concentration of dissolved salts in water. Open ocean salinity is generally in the range from 32 to 37 practical salinity units (psu). The salinity of the Gulf waters varies to a considerable extent not only with season but also with latitude as a consequence of the very large excess of evaporation over rainfall in the upper reaches of the gulf. Salinities in excess of 40‰ have been recorded above Port Pirie, grading to values of 42-44‰ at Lowly Point and 43-48‰ near Port Augusta. This variation is the result of the increasingly sheltered environments approaching the head of the gulf, and the linear character of the tidal motion in the deep-water channels. Across the entrance of the gulf, salinity values also vary annually and seasonally, between 35.7‰ and 37.3‰ (Green 1984; Edyvane, 1999b). Salinity measurements at the Port on the surface were typically 32 to 34 practical salinity units (psu), whilst at depth varied between 34 and 38 practical salinity units (psu).

5.12.3.3 Water Quality

In August 2011 water quality samples were collected to document the water quality conditions at the Project site and at locations further afield to provide information about baseline conditions. The results of the water quality assessment can be found in more detail in Appendix K; however in summary, the results of the water quality sampling programme indicated that the following:

- A number of exceedances of the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) National Water Quality Management Strategy (ANZECC & ARMCANZ, 2000) guideline occurred for chlorophyll-a.
- The reported values for total phosphorous ranged from 0.09 to 0.34 mg/L. These values did not exceed the South Australian EPP(WQ) (EPA, 2003) trigger value of 0.5 mg/L, however the majority of values exceeded the ANZECC & ARMCANZ (2000) trigger value of 0.1 mg/L.

All other reported values were either below the relevant trigger value, within an appropriate range for the parameter measured or, in instances where no trigger value was available for comparison, below the limit of reporting.

5.12.4 Sediment Mapping

A geophysical survey was carried out in September 2010 and maps were developed of the distribution of loose sediments in the vicinity of the jetty (Golder, 2010c). Along the length of the berthing wharf there is a layer of medium to fine grained sediment. Bedrock occurs at approximately 1 m below the seabed in the area of the proposed jetty. Along the length of the approach jetty a maximum sediment thickness of around 5 m occurs approximately 200 m from the shore. Either side of the jetty this maximum the sediment thickness tapers off to approximately 1 m. Mean sediment grain size for the area around the berthing wharf is 0.13 mm. Mid-way along the approach jetty mean sediment grain size increases to 0.30 mm, suggesting that sediments are being sorted by wave movements.

A rocky reef extends 50 to 70 m offshore either side of the headland inshore of the jetty. To the south and north of the Port a number of rocky headlands exist along with pocket beaches ranging in width from 20 m through to 180 m.

5.12.4.1 Sediment Characteristics

Sediment quality samples were collected during 2008, 2010 and 2011 marine surveys to document sediment characteristics at Port Spencer and at locations further afield. These data provide information about baseline conditions at the proposed Port Spencer facility. The results of the sediment quality assessment can be found in more detail in Appendix K and are summarised below:

- The sediment textures are mainly fine to medium sand, with small amounts of gravel and fines, containing silt/ mud and only minor amounts of clay.
- There were no exceedances of arsenic, cadmium, chromium, copper, lead, mercury, nickel or zinc.

- There were no Interim Sediment Quality Guidelines (low trigger values (ISQG -Low)) screening values available for aluminium, iron and manganese in ANZECC & ARMCANZ (2000) or National Assessment Guidelines for Dredging (NADG) (Commonwealth of Australia, 2009).
- Comparison between the 2008, 2010 and 2011 sediment assessments show consistent results, with almost all metals reported below detection limit. Slightly higher concentrations were reported at the mid benthic locations compared to the near shore locations.
- Tributyltin, monocyclic aromatic hydrocarbons, individual polycyclic aromatic hydrocarbons (PAHs) and total PAHs were below limit of reporting (LOR) for all samples, and
- Individual total petroleum hydrocarbon (TPH) fractions C6 – C9, C10 – C14, C6 – C10 were all below the LOR of 3 mg/kg.
 - There are few screening values for individual PAHs. Where ANZECC & ARMCANZ (2000) provide screening values for individual PAH, these have not been exceeded. The NAGD (Commonwealth of Australia, 2009) trigger value for Total PAHs was not exceeded.

5.13 Cultural Heritage

In 2008 a cultural heritage assessment was undertaken for both Indigenous, maritime and non-Indigenous heritage and is provided in Appendix M (Wood and Westell, 2008). The assessment included the following:

- Review of existing archival and published information relating to both Indigenous maritime and non-Indigenous cultural heritage
- Walkover of the Port site, and
- Interviews with local residents and historical societies.

Past agricultural work has largely altered the natural environment of the Port site. Native vegetation has been cleared as a result of those agricultural activities, with some remaining along roads. Piles of rubble were found at various locations along the edges of the paddocks. Farm related infrastructures such as fences, dams, dirt tracks and buildings are common in Port site.

5.13.1 Indigenous Cultural Heritage

According to the catalogue of Aboriginal tribes in Australia, the Port site is included within the Nao territory (Tindale, 1974). A search of the AARD archive showed there are currently no recorded Indigenous sites as defined under the *Aboriginal Heritage Act 1988* within the Port site. AARD advised that the closest recorded site is located immediately west of Lincoln Highway, outside of the Port, in the vicinity of Salt Creek (Figure 5-13, Heritage Site 1). Similarly, there are no areas or sites under the protection of the Commonwealth *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* within the Port.

The South Australian Museum (SAM) maintains a record of artefacts and skeletal remains that are collected in South Australia. The SAM records generally provide limited details of the collection sites and materials; however, the SAM records provide a useful overview of the types of artefacts that maybe found within the Port site. Table 5-9 details SAM records for the Port site.

Table 5-9: South Australian Museum Records from the Port Site and its Environs

SA Museum Reference No.	Location	Description/Content
A20481	Lipson Cove	Implement, stone, arapia type
A28423	Lipson Cove	No details
A28507	Myalpa, near Tumby Bay	Broken clay pipe
A37125	Port Neill	No details
A37127	Tumby Bay	No details
A43710	Lipson Creek	No details
A45479	Port Neill, approximately 4.8km South	Stone chippings
A454800	Port Neill	No details
A47594	Lipson	No details
A47595	Port Neill	No details
A47597	Tumby Bay	No details
A47598	Tumby Bay	No details
A48867	Port Neill	No details
A50424	Lipson	No details
A50944	Port Neill	No details
A50945	Port Neill north	No details
A52718	Lipson	No details
A52786	Port Neill	No details
A52788	Lipson	No details
A62130	Port Neill	No details
A38213	Port Neill	Skull and lower jaw
A64967	Tumby Bay	Skull and skeleton

Source: (SA Musuem, 2011)



**PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT**

**CULTURAL HERITAGE
LOCATIONS**



- LEGEND**
- ▲ Heritage Site
 - Other Locations and Points of Interest
 - Former Stock Route
 - Swaffers Road Access Corridor
 - ▲ Three Sisters Shipwreck Location
 - Project Boundary

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Aerial image sourced from Bing Maps, date sourced 28.11.2011.

Township data sourced from MapInfo Street Pro.

Aerial image sourced from Department for Environment and Heritage, South Australian Government, 2007.

Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011.

Heritage data sourced from Wood V & Westell C 2008, A Desk-top Cultural Heritage Assessment of the Proposed Centrex Metals Ltd Sheep Hill Port Facility, Eyre Peninsula, South Australia, Vivienne Wood Heritage Consultant Pty Ltd.

0 125 250 500 750 1,000 metres

SCALE (AT A4) 1:30,000

DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 5-13



Based on an assessment in terms of the distribution and style of archaeological sites and materials known to occur in the wider Eyre Peninsula, a predictive archaeological assessment of the areas surrounding the Port site suggests that a number of areas in which the archaeological sensitivity can be described as moderate to high, are noted (refer Appendix M):

- The dunes located around Rogers Beach on the north-eastern side of the Port are likely to represent a highly sensitive landform. This sensitivity is further enhanced by the presence of a water hole or soak, identified on early cadastral maps (refer Figure 5-13). It is noted the Rogers Beach dunes are outside the proposed Project footprint.
- The coastal margins, extending 50 m to 100 m inland, have a heightened archaeological sensitivity.

No locations of Indigenous anthropological significance were identified in the Port site, based on a literature review. A number of former waterholes, however, were identified during the site walkover and topographic maps of the area. These features are regarded as having some level of cultural significance. Similar features may, for instance, be related to the Moon and Seven Sisters mythology, which travels down the east coast of Eyre Peninsula (refer Appendix M).

A preliminary archaeological field assessment of the Port site and immediate surrounds identified two areas of Indigenous heritage value. The first area is located to the west of the Lincoln Highway and outside of the Port site, which is the same site that is recorded in the AARD archive (Figure 5-13, Heritage Site 1).

The second area identified during the site walkover as having Indigenous heritage value is Rogers Beach, which is also outside of the Port site and extends to the north of the Port (Figure 5-13, Heritage Site 2). The area contained widespread but generally low density scattered stone artefacts and a possible shell midden. Artefacts include quartz, granite and chert flakes, flaked pieces, hammer-stones and cores. Some isolated stone artefacts were also found across the dune surface behind Rogers Beach. Although this sand dune has a low profile, it is still possible that materials are buried underneath the sand.

The Indigenous heritage landscapes of the Port include the following:

- Archaeological materials were noted at Rogers Beach north of the Port, while extremely low density of isolated artefacts continues south onto the Port and around the headland.
- The headland where the jetty is proposed to be built is not typical for fish-traps (Martin, 1988). The steep drop-off and the wave-exposed nature of the headland make it difficult for this area to be used as fish-trap points.
- The remainder of the Port's archaeological value is significantly reduced through a long history of agricultural land activities., and
- No archaeological material was located within a number of rock exposures inspected along the proposed transport corridor. It should be noted, however, that the rock exposures bounding the northern and southern edges of the narrow gully in the Swaffers Road corridor were not inspected.

5.13.3 Non-Indigenous and Marine Cultural Heritage

The landscape of the Port has been extensively modified through a long history of pastoral and agricultural development over a century and a half. Consequently, the majority of non-Indigenous heritage items located within the Port relate to the theme of pastoral and agricultural development (refer Appendix M).

One area of non-Indigenous heritage was noted in the Swaffers Road access corridor, which had a shearing shed and yard complex next to the south side of Swaffers Road (Figure 5-13, Heritage Site 3). The area has a shearing shed, yards, ramp and chicken house extending over an area of 75 m wide and 40 m long. The shed comprises a random rubble construction with galvanised iron and a timber frame lean-to. This is a typical example of the region's agricultural sites and it is likely to have limited representative value for non-Indigenous cultural heritage. The site is not listed as a heritage site under the SA Heritage Act or the Tumby Bay District Council Development Plan (2011). Further locations of historical interest included within the Port and surrounding area are shown on Figure 5-13 and described below:

- Various refuse dumps, most of which include abandoned farm machinery and building material.
- The former water reserve shown on early mapping and now located on Mr Graham Rogers' property inland of the proposed wharf. This water reserve was shown on cadastral maps on the boundary of Sections 386 and 388, approximately 600 m inland from the jetty and adjacent to the former stock route (Figure 5-13)., and
- The former stock route. This reserve was leased by Mr Rogers and has subsequently been incorporated into larger paddocks. Historically, the Lipson Cove/East Coast route, a three-chain stock route passed through the Port area, which linked several waterholes to the north toward Ponto Creek.

Currently, there are four sites of heritage significance that have been identified outside the Port footprint in the Lipson Cove area, approximately 1.6 km to the south of the Project area. They are described in Table 5-10 and their locations shown on Figure 5-13.

Table 5-10: Summary of Cultural Heritage Locations

Heritage Feature Name	Location	Description
Lipson Cove Jetty	Southern end of Lipson Cove Road, 1.6 km south of the proposed jetty location.	<ul style="list-style-type: none"> Built in 1882 and demolished in 1949. Approximately 10 wooden pylons are visible. The site is exposed to wave and wind actions on the beach.
<i>Three Sisters</i> Shipwreck	Approximately 40 m north of the concrete slipway at Lipson Cove, 20 m north of the remains of Lipson Cove Jetty.	<ul style="list-style-type: none"> Signage provided by Tourism SA at the Lipson Cove camping ground wrongly places the wreck on the southern side of the Lipson Cove Jetty (it is actually on the north side). Listed in the National Shipwrecks Database ID: 2623, DEH Wreck Number: 215, 41 m north of the Lipson Cove Jetty. No other wrecks have been identified in the immediate area. The wreck was almost completely exposed during 1986 by a storm. According to anecdotal record, the wreck is regularly uncovered every five or six years.
Swaffer's Shearing Shed	Immediately inland of the Lipson Cove jetty and camping ground.	<ul style="list-style-type: none"> A stone shed within which Edward Daniel Swaffer used to shear his sheep, parts of which are still visible. The feature includes multiple foundations and partial random stone walling over an area of 40 m x 40 m. It has shearing shed, kitchen and water tank. The site is in poor condition and has largely fallen down.
Wallaby Sam Monument	Northern edge of a small headland at the southern end of Lipson Cove Road.	<ul style="list-style-type: none"> The feature comprises a small stone monument located above a narrow cave-shelter and erected by the Tumby Bay National Trust. The shelter is largely closed over by sand, rubble and vegetation.

Several springs located along the coast in the vicinity of the Port were significant enough to be mapped by early explorers and used by pastoralists. These water sources may have been named and utilised by Aboriginal people, and possibly even embedded in, and inked through mythological lines (refer Appendix M). Waterholes were identified at Lipson Cove and toward the northern end of the cove on the northern side of the Project area.

5.13.4 Native Title

There are currently two Native Title applications in place over the wider Port area: the Barngarla Native Title Claim (SC96/4) and the Nauo-Barngarla Native Title Claim (SAD 6021/98). The Native Title claim relates not only to the land, but also includes an area extending five nautical miles into the Spencer Gulf/Great Australian Bight.

The coastal strip of land along the eastern edge of the Port, is reported to lie directly in the path of one of the central dreaming stories belonging to the Barngarla and Nauo of the Eyre Peninsula. Both the features of the landscape and their colours are indicative of the mythology surrounding and built into this area, and joining it to the more northerly Barngarla stories and the more southerly Barngarla and Nauo mythologies.

In 2008 a coastal Work Area Clearance Survey was undertaken for the Port site. Centrex owns the freehold to the land upon which the Port is located. Native Title has been extinguished on this freehold land.

Centrex is currently liaising with DENR to secure tenure of the coastal strip and DPTI regarding tenure of the seabed upon which the jetty will be constructed, which is currently Crown Land. The relevant government departments are also responsible for administering Native Title claims for the coastal strip and seabed.

Centrex has designed the layout of the Port such that land between the high and low water mark will remain accessible during operation. Access to this area will not be permitted during the construction of the Port for health and safety reasons.

Land along the Swaffers Road corridor has not yet been secured by Centrex but preliminary communications with relevant landowners indicate that access to this land is available, though the ownership details and Native Title claims are not yet determined.

5.14 Visual Amenity

Visual amenity is a measure of the visual quality of the landscape experienced by residents, workers or visitors. It is the collective impact of the visual components and the responses of users to the scenic quality of the landscape which contributes to making a site or an area pleasant to be in. All landscapes have scenic quality, which varies according to their elements; however, the perception of the landscape can vary greatly depending on the type of user viewing the landscape. Scenic quality can vary depending on landforms, vegetation, water, colour, adjacent scenery, scarcity and cultural modifications. Responses of users depend on the type of users, amount of use, public interest, adjacent land use and special areas (USDI, 1986a).

Visual aesthetics is generally defined as the study of beauty and of the psychological responses to appearances. The nature and magnitude of aesthetic impacts perceived by an observer can vary widely depending on the observer and the type of development involved. The level of visual aesthetic impact is influenced by observer expectations, distance from observer to development location and visual quality of the development area.

Changes to the human environment, caused by components of a project (i.e. process plant, lighting used during night time operations) can impact on visual aesthetics and thereby affect other local attributes such as social cohesion and community well being.

The Port is flanked to the north, west and south by rounded hills of approximately 50 m elevation; while the coastline to the north consists of a small bay with a sandy beach, known as Rogers Beach. The Port is surrounded by farmland. There are approximately 10 households within a 5 km radius of Port. Lipson Cove is approximately 1.5 km to the south of the site and a Crown Land coastal corridor approximately 50 m wide, extends along the eastern boundary of the Port.

5.15 Socio-Economic Environment

This Section describes the local townships within close proximity to the Port, the history of these townships and provides an understanding of the local communities' values, particularly how they relate to the Port.

Social values refer to the features of the Project area and the surrounding townships that people consider to be important. This includes the ways in which each of the many groups and cultures in the region use the area, that is, for fishing, hunting, camping or picnicking, or how they appreciate the area for its beauty and their own inspiration.

Economic values refer to the current assets of the Project area and the surrounding townships and how people consider these areas as important in relation to income generation. Appendix N includes detailed socio-economic information in addition to the discussion outlined below.

5.15.1 Description of Local Area

The Project area is an extensively modified vacant site due to a long history of pastoral and agricultural development. The adjoining properties and surrounding environment are predominantly large agricultural allotments. The Project area is located within the District Council of Tumby Bay which is located on Southern Eyre Peninsula and incorporates the districts of Ungarra, Lipson, Port Neill and Tumby Bay. Tumby Bay is the main service centre for the District with smaller towns around including Port Neill, Ungarra and Lipson. Other areas include Cockaleechee, Yallunda Flat, Butler, Stokes, Moody, Koppio, Hutchison, Louth and Brooker. There are two key coastal townships for the Project, which is located 21 km north-west of Tumby Bay and 20 km south-east of Port Neill. The following Sections provide an overview of these townships.

The township of Tumby Bay (approximately 20 km south-west from the port) is an important service centre to the surrounding agricultural community with rural suppliers, insurance agencies, fuel outlets, a Royal Automobile Association of South Australia representative and mechanical suppliers all based in the township. There is a comprehensive community health service and a hospital in Tumby Bay with the large hospital in Port Lincoln. It is well equipped with a surgery, 35 bed hospital and 24 hour accident and emergency centre with short term intensive care services.

Tumby Bay also has a school (which includes reception to year 12), kindergarten, two shopping centres, sporting, and accommodation facilities. It has a motel, two hotels, self contained holiday units, flats and cabins, beach-front caravan park, backpacker accommodation and numerous take-away/dine in food outlets. Tumby Bay has a recreational jetty and community built boat ramp for boating and fishing. It is serviced by coach from Adelaide and from Port Lincoln, where there is an airport with daily flights in and out (Tumby Bay District Council, 2011).

The township of Port Neill (approximately 20 km north-east from the Port) comprises a general store, essential services and is a tourist destination for those interested in fishing, boating, sailing, water skiing and scuba diving. Port Neill has a hotel, caravan park and holiday flats. Sporting and recreational facilities include the town oval, tennis courts, golf course and bowling green. The Port Neill boat ramp and breakwater is located on the southern side of the bay and leads into deep water which provides an all-weather launching site. Port Neill is serviced daily by coach, which travels to and from Adelaide and Port Lincoln.

5.15.2 Local Community History

5.15.2.1 Tumby Bay

Like much of the coastline of the Eyre Peninsula, Matthew Flinders first explored Tumby Bay in 1802. It was not until 1900 that the town of Tumby Bay was surveyed and the first Council meeting of the District Council of Tumby Bay was held on 21 July, 1906. In 1900 when the town was proclaimed it was named "Tumby" but the local residents added the word "Bay" to it. In April 1984, at the recommendation of the Geographical Names Board, the name was officially changed to "Tumby Bay".

Settlers began moving into the area from the early 1840s. When the area was first settled in the 1840s one of the earliest settlers was named Harvey and the area was known as Harvey Bay. Wheat and sheep farming industries developed in the area and still provide the main focus today, together with a fast developing tourist trade. In the early years, Tumby Bay was an important grain and loading port servicing the cereal and sheep farming industries. Today it is a service centre for the surrounding farmers and like the rest of the area, a popular destination for holiday makers.

The Tumby Bay jetty was built in 1874, the second jetty to be built on Eyre Peninsula. The need for the jetty became apparent when ore from the Burrawing Mine was shipped through Tumby Bay. Prior to the jetty, the copper ore and other goods including wheat and wool were loaded into dinghies from drays or wagons to be transhipped out to larger vessels in deep water. In recent years a new commercial jetty has been built to replace the original jetty, which was dismantled in 1999 due to it being unsafe (District Council of Tumby Bay, 2011).

5.15.2.2 Port Neill

The first European to sight the Port Neill area was Matthew Flinders on 7 March 1802. The area around Port Neill was first settled in 1873 when the pastoralist John Tennant and his son Andrew took up land around the bay. At the time the whole area was known as Mottled Cove.

The township was gazetted in 1903 and laid out in 1909. At the time it was known as Carrow (supposedly a local Aboriginal word describing the water soaks in the area) however similarity with the township of Warrow caused some confusion and on 19 September 1940 the town was renamed Port Neill honouring a Warden of the Marine Board, Andrew Sinclair Neill.

The first jetty was built in 1912. Produce from the hinterland, mainly wheat and a little wool, was shipped out of the port until the establishment of the grain silos and bulk handling facilities in 1970. The local grain is now trucked to the Port Lincoln grain terminal (SMH, 2004).

5.15.3 Local Community Values and Lifestyle

An understanding of community values and lifestyle has been reached through a progressive and staged approach to the following activities:

- Baseline collection of data for a socio-economic assessment, including early stakeholder interviews.
- Targeted stakeholder consultation, and
- Community consultation events in Port Neill, Tumby Bay and Port Lincoln.

Early interviews with stakeholders established the following regarding community values and lifestyle. People living in the Tumby Bay Statistical Local Area (SLA) (as per the Australian Bureau of Statistics), in both the town and surrounding rural areas, nominated the community spirit of the area as a high value. Local residents valued the community interaction and kinship that comes with living in a small community. They enjoyed the trust and honesty associated with the supportive community structure. Participants depicted the towns of Tumby Bay and Port Neill as open and friendly neighbourhoods and valued their familiarity with the town's residents.

Other aspects that participants indicated they valued about the Tumby Bay local area included the following:

- Quietness of the area
- Low levels of crime and high levels of safety
- Small-town lifestyle, and
- Clean, relaxed and stress-free environment.

The rural character and geographic beauty of the area were also identified by local residents of the SLA as features of value to their lifestyle. Stakeholders interviewed valued landscape features such as the Lipson Island Conservation Park and unspoilt beaches including Rogers Beach (Golder, 2009a). Further consultation activities have endorsed the early findings of this study. Stakeholders participating in targeted and broad consultations have put forward their concerns about how the Port would impact on their current values and lifestyle. Recurring themes relating to these issues are listed below:

- Potential reduced access to Rogers Beach
- Potential environmental impacts on the beaches and marine environment
- Potential visual impacts from the Port development
- Potential traffic impacts from the construction and operation of the Port, and
- Potential impacts on power services to the Lower Eyre Peninsula.

Centrex has responded to these and other issues through regular communication with stakeholders and, more recently, with the publication of a 2011 Stakeholder Response Report (Appendix B) that collates stakeholder questions about the Project and provides Centrex's answers. For further details about the public participation activities undertaken for the Project refer to Section 1.4.

5.15.4 Baseline Socio-Economic Data

The baseline socio-economic information provides the basis for identifying, quantifying, comparing and estimating the effects arising from the socio-economic impacts of the Port. The baseline data presented in this report were derived from a combination of fieldwork and secondary data sources. A socio-economic baseline study included the regional, local and immediate study areas that could be affected by the Port. The study areas comprised the following:

- **Immediate Study Area (ISA)** – This comprised all land within a 5 km radius of the Port site. There are approximately 10 households living within the ISA. There are also several other landowners with land in the ISA who live outside the ISA.
- **Tumby Bay Statistical Local Area (SLA)** – The SLA included the coastal towns of Tumby Bay and Port Neill, the inland communities of Lipson and Ungarra, and a rural area covering approximately 2,770 km². The area has a population of 2,541 permanent residents and a population density of 1 person per square kilometre. The township of Tumby Bay, located approximately 21 km south-west of the Port is the largest town in the SLA and provides the main hub for key services and amenities for the area. The township of Tumby Bay has a population of about 1,200 and comprises a large retired population. Port Neill, approximately 20 km north-east of the Port, is the second largest township in the SLA with population of approximately 400 (ABS, 2007).
- **Eyre Statistical Division (SD)** – Referred to as the Eyre region in general. This encompasses the Statistical Local Areas (SLAs) of Ceduna, Cleve, Elliston, Franklin Harbour, Kimba, Le Hunte, Lower Eyre Peninsula, Port Lincoln, Streaky Bay and Tumby Bay. The Eyre region covers an area of approximately 55,000 km² and in 2006 had a population of 33,342. Port Lincoln is the largest urban area in the SD with a population of 13,600 in 2006 (ABS 2006). The overall population density of the Eyre SD is lower than the Tumby Bay SLA (0.5 persons/km²) (ABS, 2007).

The study areas are presented in Figure 5-14 and Figure 5-15. The socio-economic baseline study was prepared using a methodology that included a review of project information and a 2008 field survey of persons living within the immediate study area during. This was substantiated with a desktop review of reliable secondary data and statistics including the Australian Bureau of Statistics (ABS) and the Australian Bureau of Resource Economists (ABARE). Note that the data sources have been revisited in 2011 and updated in this section where possible. Details and graphical interpretation of results are presented in Appendix N.

5.15.4.1 Population and Education

Table 5-11 presents data on the population size, density and growth rates of Tumby Bay SLA, Eyre SD and South Australia. In 2007, Tumby Bay SLA had a population of 2,541 and a population density of 1 person per square kilometre. Between 2006 and 2007 the population of the SLA increased by 0.9%, which was similar, but lower, than the population growth rates of 1.2% for Eyre and 1.0% for South Australia over the same period.

Table 5-11: 2009 Population Characteristics of Tumby Bay SLA, Eyre SD and South Australia

Key Characteristics	Tumby Bay (SLA)	Eyre SD	South Australia
Total Population (2009)	2,757	35,556	1,623,590
Population Density (persons/km ²)	1.0	0.5	1.7
Population change 2008-2009 (%)	1.8	1.0	1.2

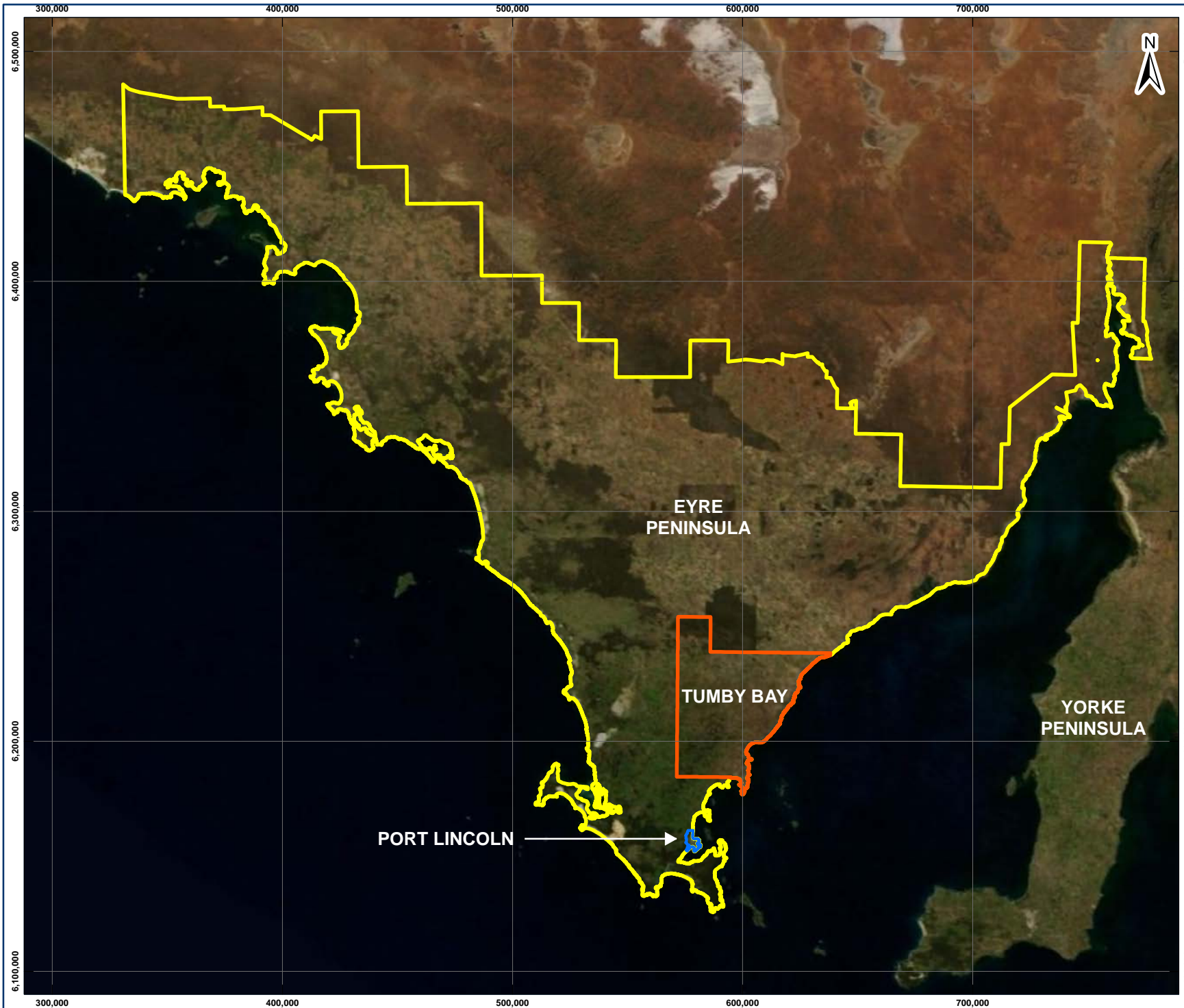
Source: ABS 2010a, ABS 2010b, ABS2011a

In 2006, the average household size in the Tumby Bay SLA was 2.3 persons. One-parent families accounted for 6.4% of the Tumby Bay SLA population, which was much lower than the South Australia figure of 16.1%. Tumby Bay had more families with no children (57.3%) compared with Eyre (43.9%) and South Australia (40%) (ABS, 2006).

The sex ratio in Tumby Bay and Eyre was 1.05 and 1.06 in 2009, respectively, comprising approximately 51% males and 49% females. In contrast, the sex ratio for South Australia was 0.98, with 49.4% males and 50.6% females (ABS, 2010a, 2010b, 2011a). Tumby Bay SLA has an older population profile, with more people aged between 45 and 69 years, and fewer young people aged 15 to 39 (ABS, 2010b). The median age of persons in Tumby Bay SLA is 47 compared with 38 and 39 in the Eyre Region and South Australia respectively. This is explained by the large retired population living in Tumby Bay town (ABS, 2006).

The dependency ratio is defined as the proportion of individuals under the age of 15 and over the age of 64. The child dependency ratio is defined as the proportion of individuals under the age of 15 relative to the working age population (aged 15-64). The elderly dependency ratio represents the proportion of individuals over the age of 64 in relation to the working age population. In 2009, Tumby Bay SLA had a child dependency ratio of 28.9%, lower than the Eyre region (32.7%) but slightly higher than South Australia (26.9%). Tumby Bay SLA had a higher elderly dependency ratio (40.8%) than both the Eyre region (23.9%) and South Australia (23.2%). These differences are explained by the older median age in the Tumby Bay area compared with the broader region (ABS, 2010a, 2010b, 2011a).

The proportion of Indigenous people living in the Tumby Bay SLA in 2006 was 0.5%, compared with 6.1% for the Eyre region and 1.8% for the State as a whole. In addition, there were fewer proportions of people born overseas in both Tumby Bay SLA (6.5%) and the Eyre region (6.8%) than in South Australia (21.5%) (ABS, 2006).



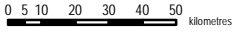
REGIONAL STUDY AREA
LOCATION PLAN

LEGEND

- Eyre Statistical Division
- Tumby Bay Statistical Local Area Boundary
- Port Lincoln Statistical Local Area Boundary

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bing
 (c) 2010 Microsoft Corporation and its data suppliers
 Aerial image sourced from Bing Maps, date sourced 28.11.2011.
 Local Government data sourced from the Department of Planning and Local Government, South Australian Government, November 2008.
 Census boundary data sourced from the Australian Bureau of Statistics, Commonwealth of Australia, November 2008.



SCALE (AT A4) 1:2,250,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 5-14





LOCAL STUDY AREA
LOCATION PLAN



LEGEND

- Project Boundary
- Tumby Bay Statistical Local Area Boundary
- Immediate Study Area (ISA) Boundary
- Township
- Road

COPYRIGHT

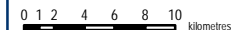


(c) 2010 Microsoft Corporation and its data suppliers
Aerial image sourced from Bing Maps, date sourced 28.11.2011.

Local Government data sourced from the Department of Planning and Local Government, South Australian Government, November 2008.

Census boundary data sourced from the Australian Bureau of Statistics, Commonwealth of Australia, November 2008.

Township data sourced from MapInfo Street Pro



SCALE (AT A4) 1:500,000

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FIGURE 5-15



The proportions of people speaking a language other than English at home were also fewer in the Tumby Bay SLA (0.7%) and Eyre region (2.7%) compared to South Australia as a whole (12.7%). These figures indicate that relatively few ethnic minority groups are present in the Tumby Bay SLA and Eyre region.

In 2006, 25.4% of the Tumby Bay SLA population aged 15 years and older had completed Year 12 or equivalent compared with 27.5% for Eyre region and 38.3% for the State as a whole. The proportion of people aged 15 and above with a degree or higher in Tumby Bay SLA was 6.7%. This is slightly less than the Eyre region where 6.9% held a degree or higher and was lower than the State figure of 13%. Tumby Bay SLA and Eyre region also had lower proportions of people with diplomas (ABS, 2006).

In contrast, proportions of people with Certificates in both the Eyre region and the Tumby Bay SLA compare more favourably with South Australia as a whole. In 2006, the Eyre region had a higher proportion of people with Certificates I, II, III and IV than the State, 38.61% and 32.15% respectively, and equal proportions of people holding Certificates not further defined, 3.68% and 3.56% respectively (ABS, 2006). Tumby Bay SLA had a slightly lower proportion of people with Certificates I, II, III and IV, with a percentage of 33.99% (ABS, 2006), than the Eyre region and South Australia and similar proportions of people with Certificates not further defined (4.67%).

These statistics are consistent with the types of employment in the Eyre region and Tumby Bay SLA; agriculture, fishing and forestry are major employment industries with low proportions of people working in skilled, service sectors. The data may also be a reflection of the relatively low proportions of younger adults in the region as younger persons generally have higher qualification levels than older people. Furthermore, State percentages include statistics for the Adelaide region where there are higher proportions of people working in skilled, service sectors requiring post school qualifications (ABS, 2006).

5.15.4.2 Tumby Bay SLA: Community Services and Infrastructure

This Section presents data on the locations and provisions of key community infrastructures in the Tumby Bay SLA. This information provides a comprehensive profile of the current community services in the local area in order to gain an understanding of community needs and issues that may be relevant to the project.

Schooling

Tumby Bay town has one state government school, which caters for grades reception to 12. The school has a strong enrolment rate and overall enrolment increased by 20 students from 2006 to 2007. The school also has a relatively high pupil and staff retention rate. Only two students from Year 9 and three students from Year 10 transferred to Non-Government Schools in 2005. In 2006 there were no students who transferred to Non-Government Schools. In 2007, the school employed 22 permanent staff, 80% of which had Bachelor degrees. Year 11 and 12 students leave if they have been successful obtaining employment elsewhere (Tumby Bay Area School, 2007).

Port Neill has one primary school, however enrolment levels are weak and the school is currently struggling to sustain itself due to low levels of demand. Some children living on rural properties in the ISA and wider Tumby Bay SLA undertake distance education and are taught from home, according to interviews with local farmers undertaken as part of the socio-economic baseline study.

Health Facilities

Tumby Bay has a 35-bed hospital which services the SLA and provides a comprehensive acute and residential care service, maternity services and community nursing services. There is also a 24 hour Accident and Emergency service and short-term intensive care services. Attached to the Tumby Bay Hospital is the Uringa Hostel, a low care facility for the aged. As part of the Lower Eyre Regional Health Service, there is also a comprehensive Community Health Service.

A larger modern 50-bed hospital complete with High Dependency Unit, Renal Dialysis, and operating facilities is located in Port Lincoln 35 km south of Tumby Bay. The hospital comprises a comprehensive Community Health department and a 24-hour Accident and Emergency service is available for emergency cases (SA Department of Health, 2006).

Police Service

The only police station in the Tumby Bay SLA is situated in Tumby Bay town, with one police officer for the whole SLA. Opening office hours of the station vary daily with a sign placed on the door to indicate the opening hours for the following day.

Fire Service

Tumby Bay Country Fire Service is located on West Terrace, Tumby Bay and serves the district area as found in the socio-economic baseline study. It is staffed by volunteers from the local community.

State Emergency Service

Tumby Bay has a volunteer emergency services branch, the State Emergency Service (SES) with a marine rescue vessel. The unit is very active in road crash rescue on the Lincoln Highway north to Port Neill. More information about direct impacts on emergency services and stakeholder consultation with the SES can be found in the impact assessment section of this document (refer Section 6).

Public Transport

There are no public transport services in Tumby Bay. Transport is restricted to private vehicles and school buses for children. Although the town does have a sealed airfield, it is not usually used for private flights, rather for the Flying Doctor and crop spraying aircraft. The town is serviced daily by a Premier Stateliner coach service. The Council owns a 19 seat bus that is available for hire by persons in the Council District.

Waste Facilities

Waste refuse sites in Tumby Bay SLA are located at the towns of Tumby Bay, Port Neill and Ungarra. According to Tumby Bay Council, these facilities are planned for closure and will be replaced by a new regional waste management site to be located in the SLA.

Recreation and Community

Tumby Bay has a variety of recreation and leisure facilities, including football, cricket, netball, basketball, tennis, bowls and golf clubs. Most of the clubs compete in local leagues.

A number of community and service groups are active in the Tumby Bay SLA area. These include the following:

- Tumby Bay Activity Group
- Tumby Bay Agricultural Bureau
- Tumby Bay Homes Inc.
- Tumby Bay Landcare Group
- Tumby Bay Hospital & Health Services
- Tumby Bay Red Cross
- Tumby Bay National Trust
- Tumby Bay Senior Citizens Club
- Tumby Bay School Governing Council
- Tumby Bay School/Community Library
- Port Neill Progress Association
- Port Neill Agricultural Bureau
- Ungarra Progress Association
- Ungarra Hall Committee
- Ungarra Agricultural Bureau, and
- Lipson Progress Association

5.15.5 Regional Economic Activity

The major industries of the Eyre region are agriculture (in particular sheep and grains), fishing, aquaculture and tourism. Key projected growth industries include tourism and mining. Heavy current dependence on agriculture makes the Eyre regional economy highly dependent on seasonal and environmental factors.

5.15.5.1 Agriculture

Agriculture is the largest industry within the Eyre region. The main agricultural activities in the region include the following:

- Cereal crops (wheat and barley)
- Sheep
- Cattle.

The region's water-intensive farming activities such as dairy farming are located in the Lower Eyre Peninsula. However, the Eyre region's overall contribution to the value of total milk and egg products in South Australia is negligible (0.14% and 1.63%, respectively (ABS, 2011b)).

In the Eyre region, approximately 30% of all farms are small with an estimated value of agricultural operations (EVAO) of less than \$AUD150,000 representing an estimated 6% of the total value of agricultural operations in the Eyre region. The majority of the region's agricultural production occurs on medium and large sized farms with an EVAO of between \$AUD150,000 and \$AUD600,000. Approximately 62% of the value of agricultural production is from farms with an output of more than \$AUD500,000 (ABARE, 2010). As of 2006, broad acre farms account for approximately 95% of farms. Of these, 85% produce grain crops, or combined grain with livestock production, usually sheep (ABARE, 2006).

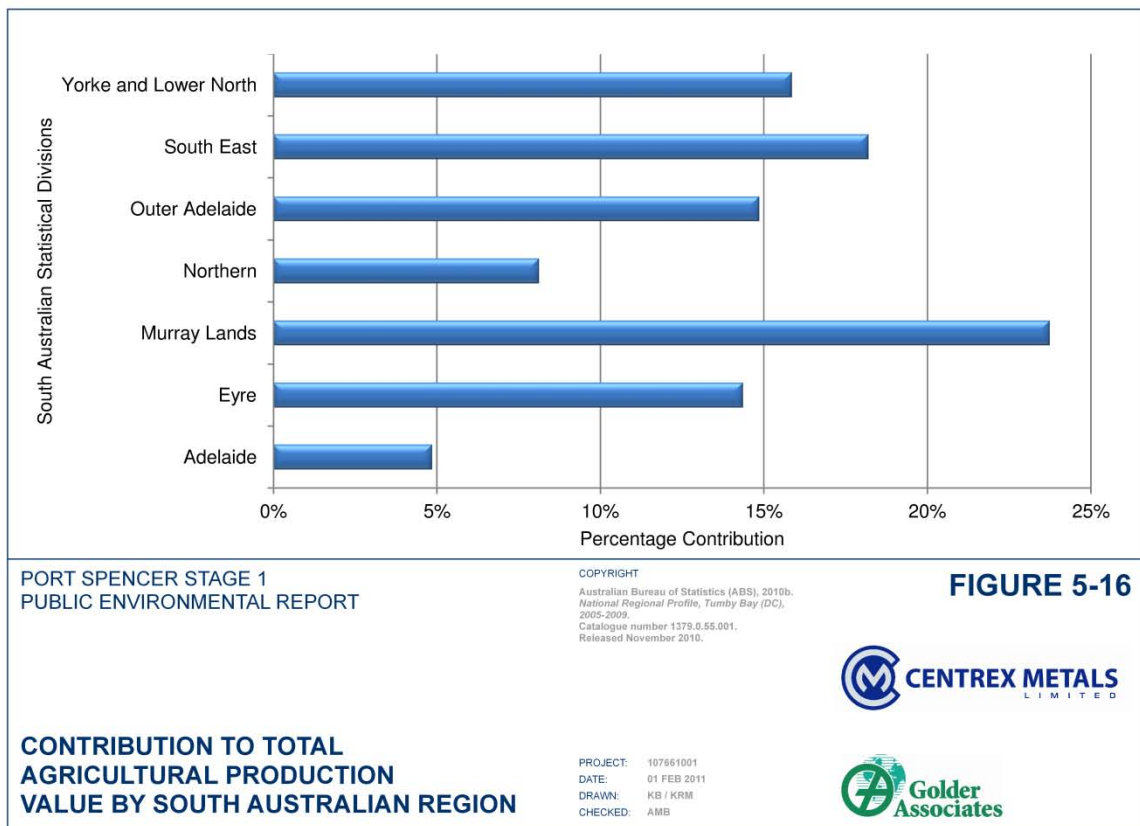
5.15.5.2 Contributions to State and National Agricultural Production

The total value of agriculture in South Australia in 2009-2010 was approximately \$AUD4.6 billion. In 2007-2008 it was \$AUD5.2 billion, a decrease of approximately 13%. The vast majority of agricultural commodities in South Australia are produced in regional economies with key contributors being the grains, aquaculture and mining sectors. In 2009-2010, the total value of agricultural production for Australia as a whole was \$AUD39.6 billion, thus the South Australian economy generated approximately 12% of the nation's total agricultural value for this period (ABS, 2011b).

Cereal crops, particularly wheat, oats and barley, dominate the Eyre region's agricultural activities producing around 25-30% of the State's annual total value of cereal grain production. The Eyre region typically produces around 46% of South Australia's wheat, 34% of the oat and about 25% of the barley (ABS, 2011b) with an average gross value of production (GVP) for agriculture of \$AUD500 million (ABARE, 2006).

Figure 5-16 displays the percentage contribution of each South Australian statistical division to total agricultural production within South Australia. In 2009-2010, the Eyre SD contributed 14.37% to the total GVP for agriculture for the State, third lowest after Northern and the Adelaide regions. The Eyre region generated approximately 18.66% of the State's crop value in 2009-2010 and 8.48% of the State's livestock products (ABS, 2011b). These figures reflect an increase in agricultural output for the Eyre region in recent years.

Figure 5-16: Contribution to Total Agricultural Production Value by South Australian Region



Source: ABS, 2011b

5.15.5.3 Fishing and Aquaculture

Eyre Region

Fishing and aquaculture form the region's second largest industry. The Eyre region accounts for 73% of the State's seafood production and 88% of South Australia's aquaculture production by output and 74% by employment. In 2009-2010, the direct value of aquaculture industry output in the Eyre region (including flow-on output) was approximately \$AUD375 million. In the Eyre region, the aquaculture industry employs 1,820 people directly and in downstream activities (EconSearch, 2011).

Tuna farming and oyster growing are the region's largest employers with growth predicted in oysters, mussels, abalone, finfish, marron and yabbies and a modest decline predicted for tuna. Oyster and tuna farming contributions to the Gross Regional Product (both direct and indirect) were approximately \$AUD127 million for the Eyre region in 2009-2010 (EconSearch, 2011). Many coastal towns have commercial fishing, in particular Port Lincoln, which had a large tuna-fishing fleet that is gradually being converted to fish farming in bays along the coast. In recent years seafood exports have been subject to increasing pressure from a combination of market price fluctuations, currency exchange rates and an increase in global competitiveness (Eyre Regional Development Board, 2007).

South Australia

South Australia has a strong, viable commercial fishing industry. In 2007-2008 the State's fishery production was valued at \$AUD468 million and constituted approximately 21% of Australia's total production. The industry is an important source of employment for the State, both directly and indirectly, and as an earner of export dollars. The State earned 57% of its seafood income of \$AUD468 million from fresh and frozen fish exports in 2007-2008 (ABS, 2010c). The State average gross income per boat ranged from approximately \$AUD36,000 in the marine scale-fish fishery to \$AUD750,000 in the abalone fishery in 1997-1998. This increased to a range between \$AUD103,000 in the marine scale-fish fishery to \$AUD1.16 million in the sardine fishery in 2007/08 (EconSearch, 2009).

The average landed real price per kilogram across all South Australian fisheries (in 1990-1991 dollars) decreased approximately 51% between 1990 and 2007-2008. This was largely attributed to the increase in the contribution of sardine catch. Over the period 1990-1991 to 2007-2008 gross value of production (GVP) across all fisheries increased by 103% in nominal terms or 28% in real terms, due to a rise in total catch and despite a fall in the average landed price (EconSearch, 2009).

5.15.5.4 Tourism

Tourism is the Eyre region's third largest industry behind agriculture and fishing. It is one of the region's key growth areas. In 2009-2010, there were more than 1,200 tourism-related businesses in the Eyre region with 43% being non employing business and 51% being micro or small business enterprises.

In 2009/10, the Eyre region attracted 667,000 visitors of which 51% were domestic overnight visitors. In 2009/10, \$AUD215 million was spent by visitors in the region with domestic overnight visitors accounting for 79% if the total expenditure (Tourism Research Australia, 2011). There were 14,000 international visitors to the Eyre region in 2009-2010, staying an average of 8 nights.

5.15.5.5 Mining

Eyre Region

Mining is an important contributor to the Eyre regional economy. Iron ore, gypsum and salt are the largest commodities currently being mined in the region; however, production of heavy mineral sands continues to increase. The mining operations in the Eyre region contribute \$AUD517 million to the South Australian economy with approximately 95% of the total contribution from iron ore (Regional Development Australia, 2011).

Exploration activities in the Gawler Craton region reached \$AUD200 million in 2008 and there have been increased levels of exploration for commodities including heavy mineral sands, iron ore, gold, silver, kaolin, uranium, nickel, petroleum and gas (Eyre Regional Development Board, 2007).

Current major mines and key resource projects in the Eyre region are listed below:

- Centrex Metals Ltd, Wilgerup – iron ore
- IronClad Mining Ltd, Wilcherry Hill – iron ore
- Iron Road Ltd, Warramboe – iron ore
- Lincoln Minerals Ltd, Gum Flat – iron ore
- Lymex Ltd, Bramfield – iron ore
- Minotaur Exploration Ltd, Poochera - kaolin
- OneSteel Ltd, Middleback Ranges – iron ore
- OneSteel Ltd, Iron Chieftan – iron ore
- Samphire Uranium Pty Ltd, Samphire – uranium, and
- Terramin Australia Ltd, Menninnie Dam – lead and zinc.

South Australia

The South Australian mining industry contributed 3.9% to Gross State Product in 2006-2007 down from 4.5% in 1994-1995. Mining related commodities constituted 26% of the value of all exports from South Australia in 2006-2007 and employed approximately 11,175 people. The value of mineral commodities produced in South Australia in 2005-2006 was \$AUD3.265 billion (ABS, 2008). The South Australian State Government aims to increase private investment in mining over the next decade. Key objectives of the South Australia's Strategic Plan (Government of South Australia, 2011) are listed below:

- Maintain exploration expenditure in excess of \$AUD200 million per annum until 2015.
- Increase the value of minerals production to \$AUD10 billion by 2020, and
- Increase the value of minerals processing to \$AUD10 billion by 2020.

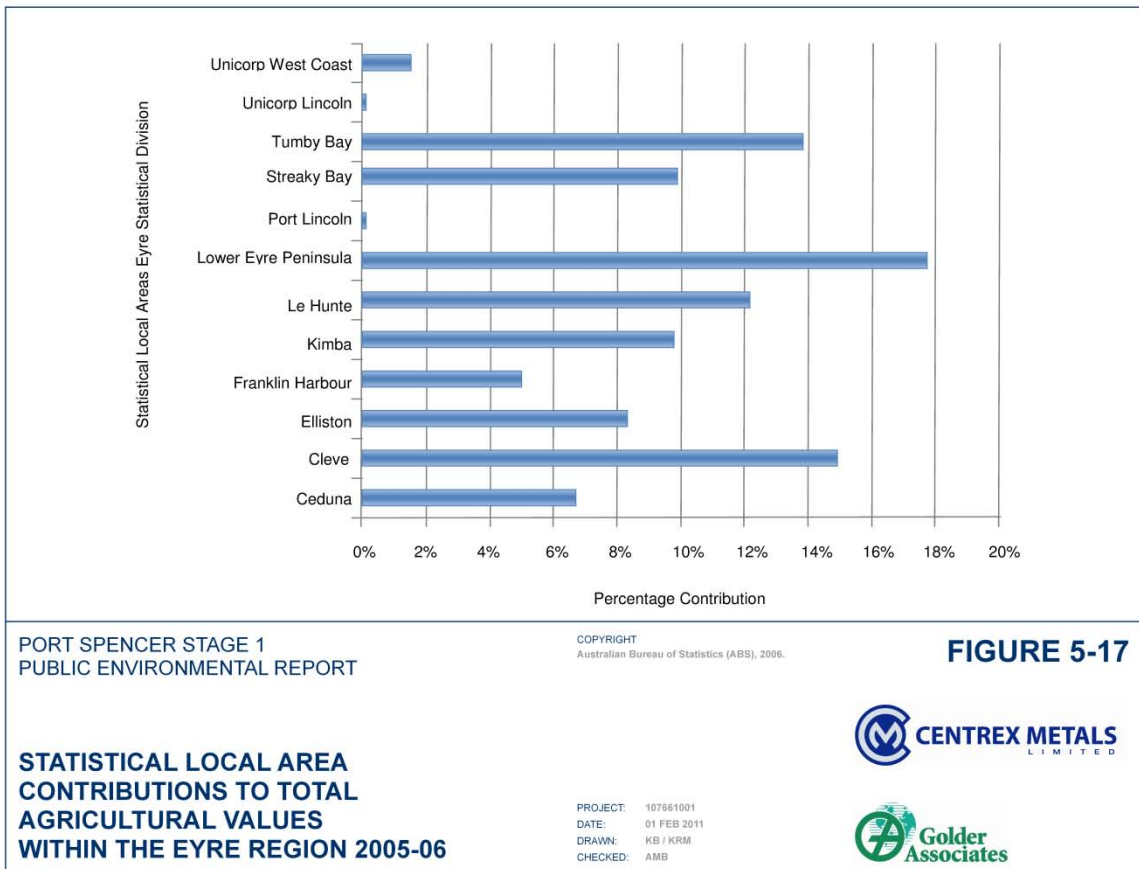
5.15.6 Tumby Bay SLA: Economic Activity

The following provides an economic profile for the Tumby Bay SLA. Tumby Bay town is a service centre for the surrounding farmers and has become an increasingly popular destination for holidaymakers. Agricultural activities dominate the economy of the Tumby Bay SLA.

5.15.6.1 Agriculture

Sheep and grain production are the largest contributors to the Tumby Bay SLA and township economy. Wheat and barley are the chief grain crops grown in the area. Figure 5-17 displays SLA agricultural contributions to the Eyre regional economy (comprising the Eyre SD). In 2005 - 2006, Lower Eyre Peninsula was the richest SLA in terms of agricultural output, producing 17.72% of the Eyre region's total agricultural value. Tumby Bay SLA ranked third, contributing 13.86% to regional agricultural value (ABS, 2006).

Figure 5-17: Statistical Local Area Contributions to Total Agricultural Values within the Eyre Region 2005 - 2006



Source: ABS, 2010b

During the period, Tumby Bay SLA contributed 9.79% of the region's total value of sheep products and 10.72% of the total value of livestock products, ranking fifth in both aspects. The rising value of livestock in recent years has rejuvenated interest in the sheep industry in the local Tumby Bay area, which has resulted in increased reinvestment into sheep and wool. Farms in the area combine growing grain crops with sheep production on mixed farms.

5.15.6.2 Tourism

Tumby Bay SLA has become an increasingly popular tourist destination, with fishing being a major attraction. A large marina was constructed in Tumby Bay in 2001, which has allowed for easier launching of boats, as well as development of nearby areas. Visitors are also attracted by the area's scenic stretches of coastline, quiet and safe swimming beaches and scenic coastal and inland tourist drives. Tumby Bay and Port Neil both have jetties for land-based anglers and the Sir Joseph Banks Group of Islands located approximately 22 km to the south of the Port is a popular site for sightseeing, fishing and diving activities. Tourism in the wider area has been enhanced by the construction of the Port Lincoln Hotel and will benefit from the future upgrade of Port Lincoln Airport, 30 km south of the township of Tumby Bay.

5.15.6.3 Commerce and Retail

The township of Tumby Bay provides a number of shopping and other commercial services to support the regional agricultural precinct and the town's population. Commercial services include a small supermarket, a pharmacy, a hardware store, a petrol station, a post office, two small hotels, a caravan park, a general grocery store, hairdressers, gift shops, a bakery and restaurants. There are no commercial services in Lipson and limited services in Port Neill including a licensed restaurant, a caravan park, holiday flats and a small number of shops (Tumby Bay District Council, 2011).

5.15.7 Employment

Figure 5-18 displays a breakdown of occupational types for the Tumby Bay SLA, Eyre region and South Australia. This data has been derived from 2006 census data. This figure highlights the dominance of agriculture, forestry and fishing as the major employing industry in Tumby Bay SLA and the Eyre region. Because of this dominance, the proportions of employment in most other industries in these areas are significantly below the state average.

Sheep, cattle and cereal grain production employs 35.0% of persons aged 15 and over in the Tumby Bay SLA. This is comparable with other rural areas in the Eyre region including Cleve (36.4%), Streaky Bay (27.8%) and Elliston (42%). The other major industries of employment for Tumby Bay SLA include school education, accommodation, road freight transport and supermarket and grocery stores (ABS, 2006). Aquaculture is not a dominant industry of employment in the Tumby Bay SLA compared to other Eyre region SLAs such as Port Lincoln, Lower Eyre Peninsula and Ceduna. In these regions, aquaculture constituted between 4-5% of employment.

High dependency on agriculture means that Tumby Bay, like other rural and regional areas, is susceptible to shocks from market forces and environmental conditions that affect agricultural productivity and profitability. The South Australian Government and Regional Development Australia – Whyalla and Eyre Peninsula Incorporated (RDAW&EP), formerly known as the Eyre Regional Development Board (ERDB) are encouraging diversification in the regional economy through support for the following:

- Mining
- Tourism industries, and
- Infrastructure development.

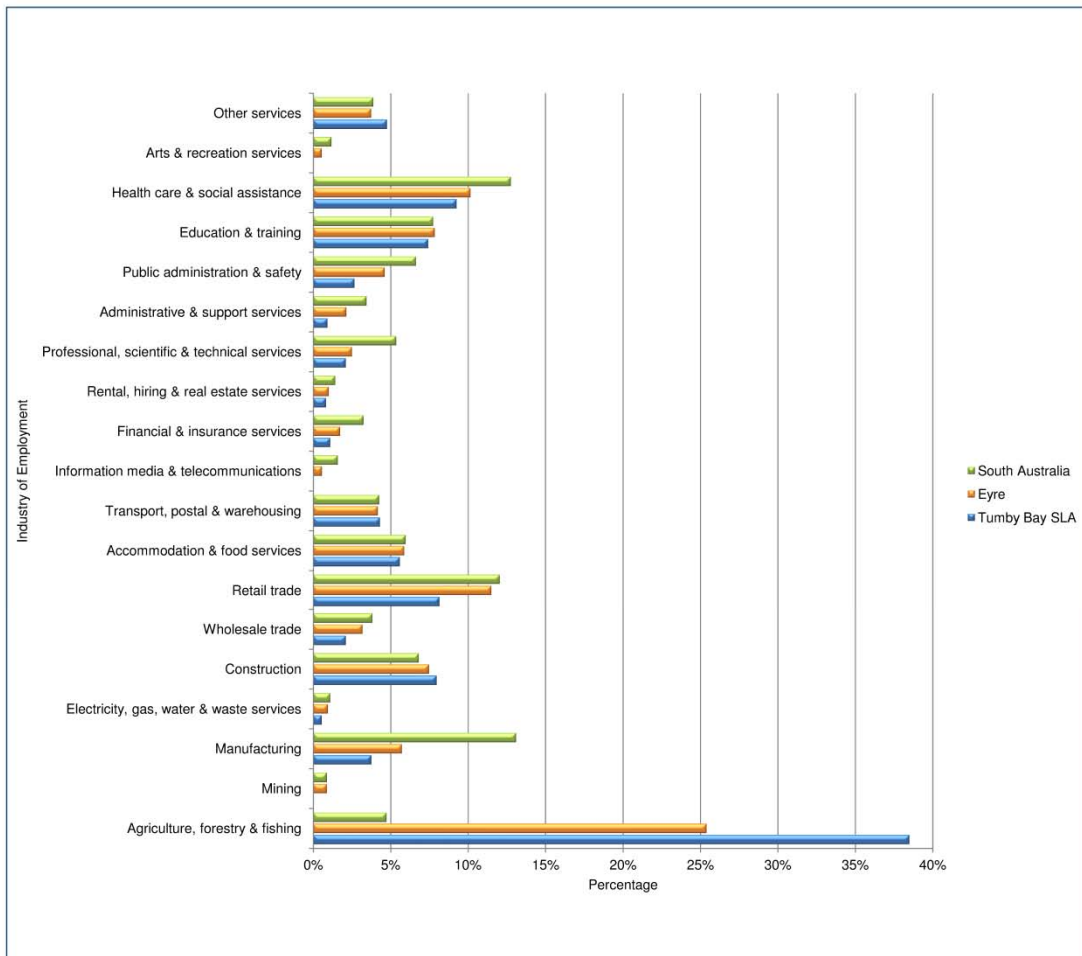
Between 2001 and 2006, there was a major increase in employment in mining for the Eyre region. However, this growth was from a low level and the numbers of people affected were comparatively small. Over this same period there was also a strong increase in employment in health and community services and construction (DFEEST, 2010).

5.15.7.1 Unemployment

Unemployment rates in Tumby Bay SLA were 3.7% in 2006, which was lower than the State unemployment rate of 5.3% and a decrease from the 2001 level of 6.4% (ABS, 2001 and ABS, 2006). The unemployment rate in the Eyre region rose from early 2008 before dropping again around mid-2009. As of 2010, the unemployment rate in the Eyre region was 3.7%, which is also significantly below the state level (DFEEST, 2010).

The nature of Tumby Bay SLA, being a rural area where large numbers of people are self-employed or employed in agriculture and the relatively low proportions of young people would explain low unemployment levels for the region.

Figure 5-18: Industry of Employment in Tumbly Bay Statistical Local Area, Eyre and South Australia



PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

COPYRIGHT
Australian Bureau of Statistics, 2006.

FIGURE 5-18

**INDUSTRY OF EMPLOYMENT IN
TUMBY BAY STATISTICAL LOCAL AREA,
EYRE AND SOUTH AUSTRALIA**

PROJECT: 107661001
DATE: 01 FEB 2011
DRAWN: KB / KRM
CHECKED: AMB

Source: ABS, 2006

5.15.8 Income Levels

5.15.8.1 Household Income Levels

Owing to a high reliance on agriculture, income levels in the Eyre SD tend to vary significantly from year to year compared to the national average (ABARES, 2006). In 2006, income levels were low across the Eyre SD compared to State median incomes. Tumby Bay had the lowest household and individual median weekly income levels of any SLA in the Eyre SD. Median individual weekly income levels in Tumby Bay were \$AUD353 in comparison with \$AUD410 and \$AUD433 in Eyre region and South Australia, respectively (DFEEST, 2010). However, a comparison of incomes with other nearby SDs, including Pirie, Yore and Flinders Ranges, shows that median individual weekly incomes in these areas were similar to Tumby Bay. The presence of Port Lincoln, a populated urban area, within the Eyre SD increases the median individual and household incomes for the Eyre region. This inflates the values of incomes in the Eyre SD and biases comparisons with other areas that do not include a large town, including Tumby Bay SLA (refer Appendix N).

5.15.8.2 Wage and Salary Employment

Approximately one quarter of the population of Tumby Bay SLA is a wage or salary earner. Port Lincoln SLA is home to the major urban centre of Port Lincoln town. It has a considerably higher total income from wage and salary employment than other regional and remote areas.

5.15.8.3 Farm Income Levels

Since 2005, the Eyre region has experienced sharp declines in farming incomes, profits and increasing debt levels. Lower income levels in rural areas of the Eyre region, including Tumby Bay, are primarily a result of the rural nature of employment and industry and poor farming conditions in recent years.

Figure 5-19 displays ABARES (2010) time series data on broad acre farm cash income levels since the 1990s for the Eyre region, South Australia and Australia as a whole. Nationally, average farm incomes increased between 2007-2008 and 2008-2009 but declined in 2009-2010. This recent decline in farm incomes is due to lower prices for grain and oilseed crops, lower beef cattle prices, reduction in beef cattle turn-off and lower wool production. In South Australia, farm incomes increased in 2009-2010 due to much higher grain production. Eyre region made considerable income gains between 2000 and 2005 but dropped off between 2006 and 2008. In 2008-2009, grain yields increased in the Eyre region resulting in an increase in farm income. In 2009-2010, the Eyre region had significantly higher wheat yields due to favourable seasonal conditions and higher rainfall in spring resulting in an increase in farm income even with a drop in grain prices.

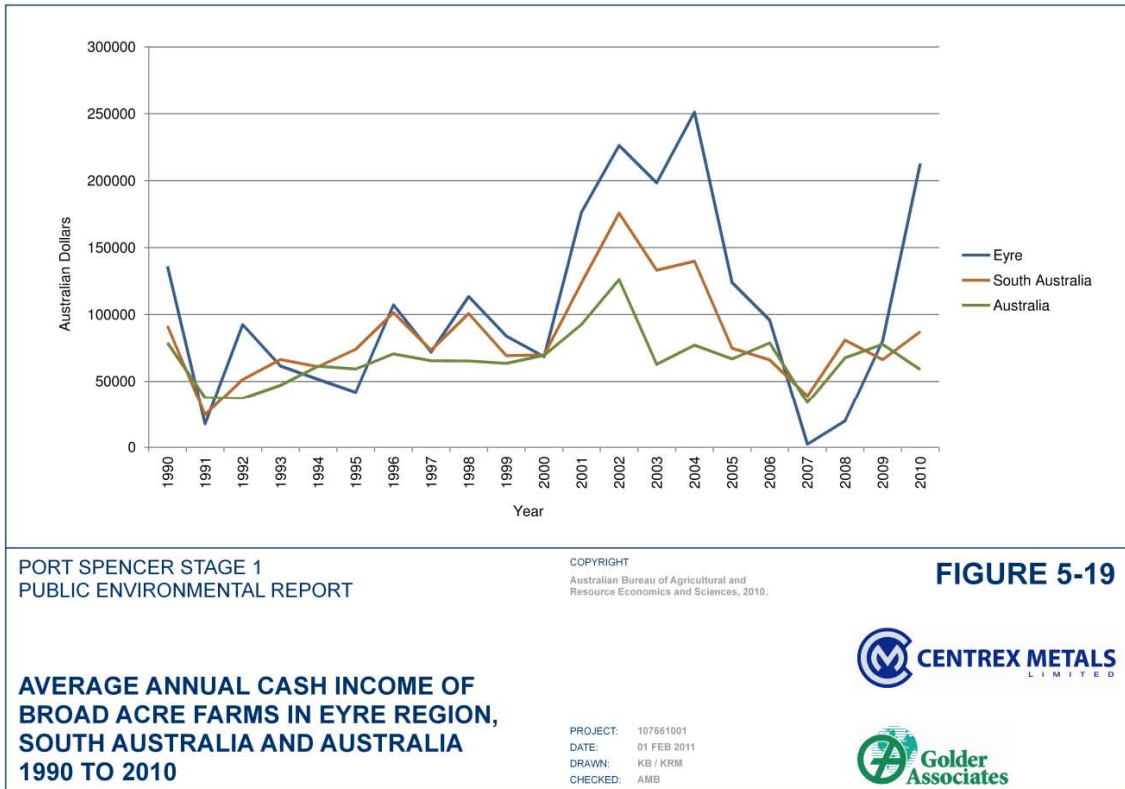
Income levels have increased in the Eyre region, South Australia and Australia in recent years, although Australia has seen a drop in 2009-2010. Cash income levels in the Eyre region have risen particularly sharply and at a faster rate than South Australia and Australia. Income levels in the Eyre region for broad acre farms declined from a peak of \$AUD251,213 in 2004, to \$AUD2,307 in 2007 and had recovered to \$AUD212,763 in 2010 (ABARES, 2010).

Figures 5-20, 5-21 and 5-22 display ABARE 1990 to 2010 time series data for the Eyre region, South Australia and Australia. Data is presented on the following:

- Broad acre farm business profits
- Rates of return (including capital appreciation), and
- Increases or decreases in farm debt levels.

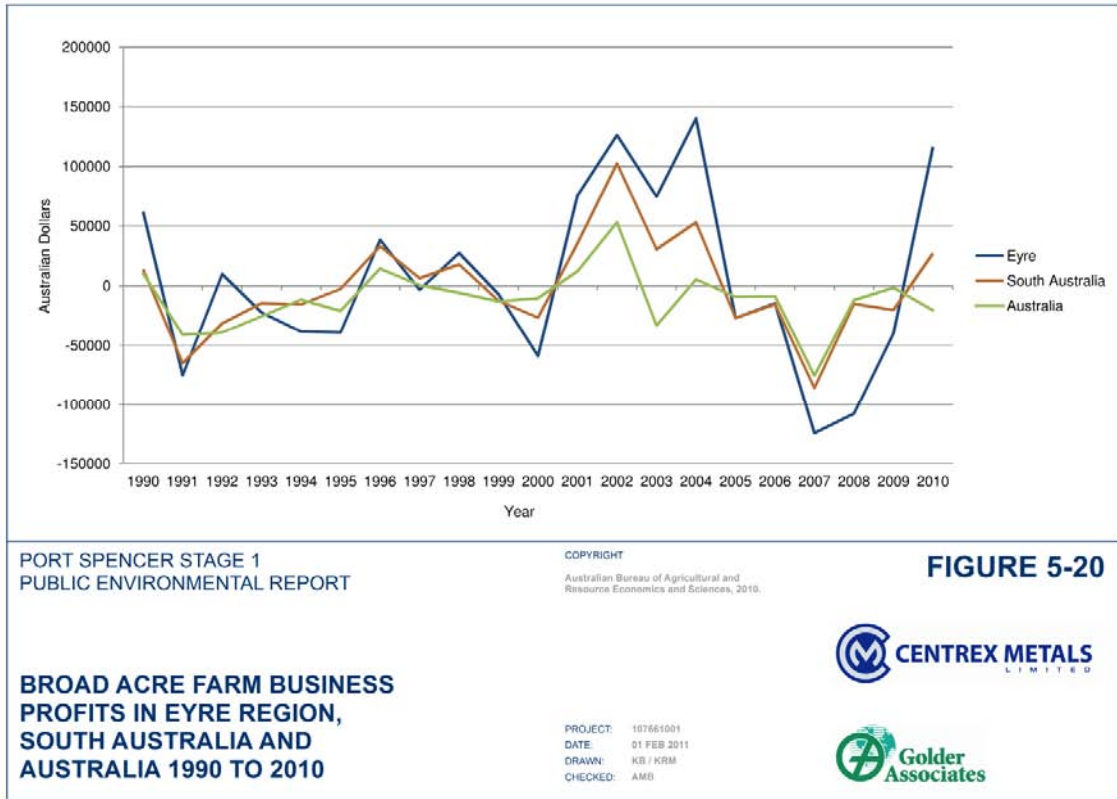
The Eyre region, South Australia and Australia experienced large declines in farm business profits in 2007 but these areas have largely recovered, with a significant recovery noted for the Eyre region. Rates of return have been positive for the Eyre region and South Australia but the recovery for Australia as a whole has not been as forthcoming and were still negative as of 2010.

Figure 5-19: Average Annual Cash Income of Broad Acre Farms in Eyre Region, South Australia and Australia 1990 to 2010



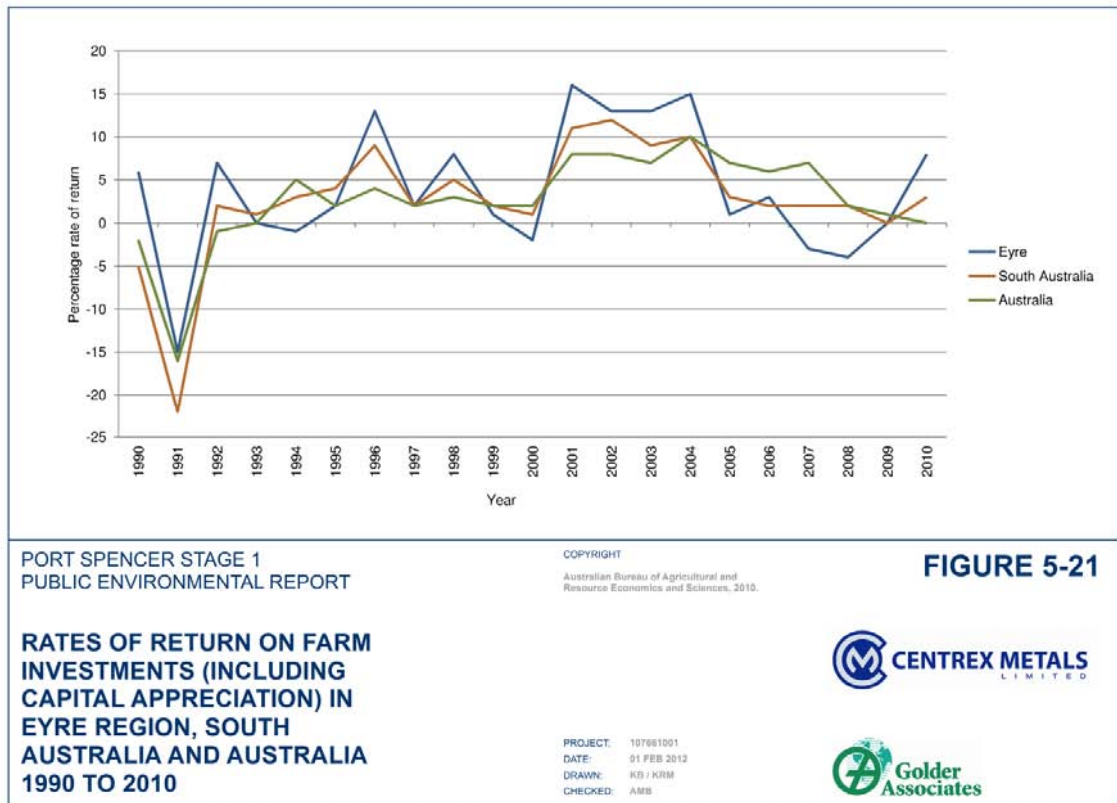
Source: ABARES, 2010

Figure 5-20: Broad Acre Farm Business Profits in Eyre Region, South Australia and Australia 1990 to 2010



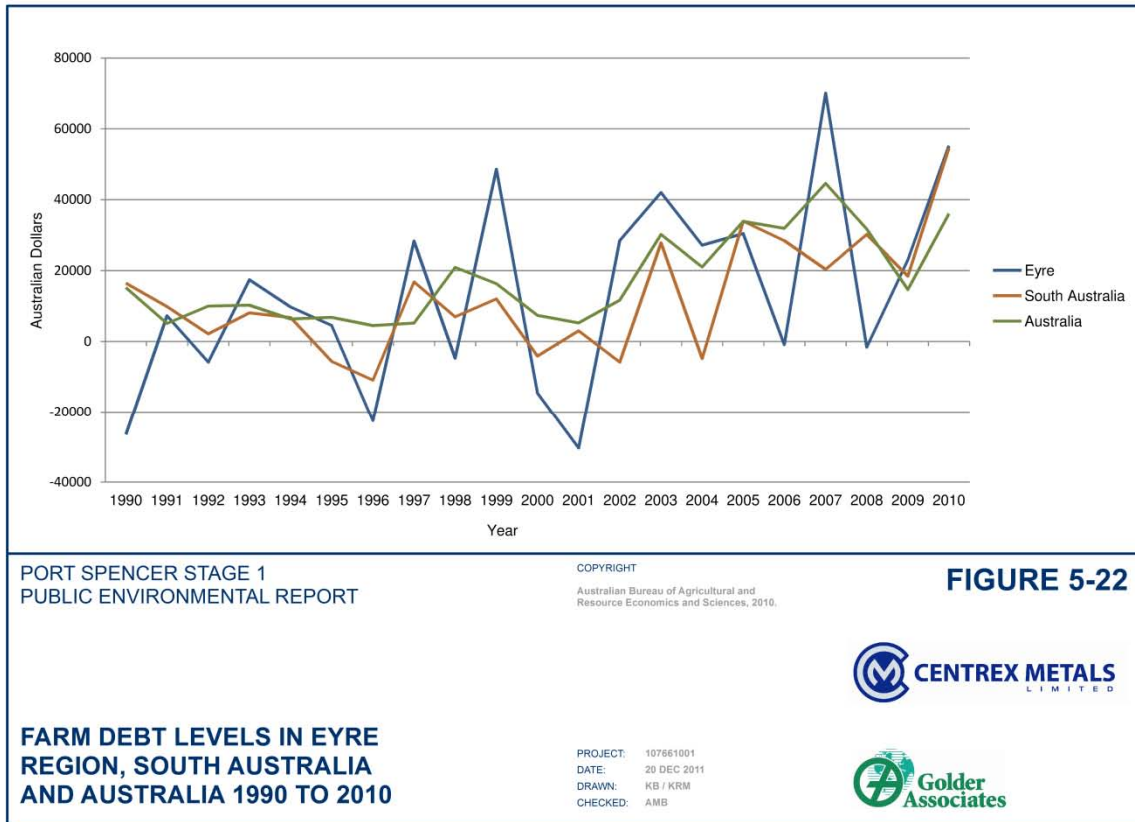
Source: ABARES, 2010

Figure 5-21: Rates of Return on Farm Investments (Including Capital Appreciation) in Eyre Region, South Australia and Australia 1990 to 2010



Source: ABARE, 2010

Figure 5-22: Farm Debt Levels in Eyre Region, South Australia and Australia 1990 to 2010



Source: ABARE, 2010

Figure 5-22 displays increases and decreases in farm debt levels for the Eyre region, South Australia and Australia. Data indicates that changes have been particularly volatile for the Eyre region during the period. In 2010, the Eyre region has experienced increases in farm debt levels in line with state or national levels.

The 2010-2011 year resulted in continued above average yields due to higher than normal rainfall. The value of livestock has also risen and reinvestment in meat and wool has positively affected the Eyre region (Regional Development Australia, 2011).

Broad acre farm cash incomes for South Australia increased substantially in 2009-2010 due to higher grain production compared to previous years (approximately 4% above the average farm cash income recorded from the previous ten years). Beef cattle receipts were reduced while sheep and lamb receipts increased due to higher prices. In 2008-2009, the rate of return on farm incomes (including capital appreciation) within the Eyre region was 0.1% (rate of return including capital appreciation was not available for 2009-2010) (ABARES, 2010).

The current, heavy reliance of Tumby Bay on agriculture leaves the area particularly vulnerable to unfavourable market and environmental farming conditions. Farmers interviewed in the ISA reported significant financial losses and erosion of financial reserves and assets in recent years. Farmers cited the recent droughts and the high cost of agricultural inputs such as fuel and chemicals as contributors to these financial losses.

A number of farmers interviewed expressed a desire to reduce crop production in future years and increase sheep numbers. This is due to the perception that it is a more profitable enterprise in the current climate. Farmers reported an increase in the sale of farms by households seeking to leave the area. Interviewees also expressed concerns related to an increase in farm costs associated with higher oil prices and lower wool prices. The concerns raised by the interviewees support secondary evidence which indicates large declines in farm incomes and high debt levels within the Eyre region in recent years.

Low income levels for the Tumby Bay SLA at the time of the 2006 census can be explained by the following factors:

- High proportion of the population employed in agriculture
- Adverse farming conditions and low farm income levels in recent years
- Absence of a large town
- Significant retired population, and
- Relatively low percentage of wage and salary earners.

5.15.8.4 Income Distribution

Tumby Bay SLA has a higher proportion of low to middle income households than the State and a lower proportion of high income households than the State. A high proportion of retirees and people employed in agricultural industries as well as the absence of a large urban centre all contribute to the distribution of household income in the SLA.

5.15.9 Housing

In 2006, 48.2% of households were fully owned in Tumby Bay SLA compared with 37.8% for Eyre region and 34% for South Australia. A lower proportion of homes were being bought or rented in the Tumby Bay SLA compared with the wider region. Median weekly rent rates were \$AUD95 in the Tumby Bay SLA compared to \$AUD150 for South Australia as a whole. Median housing loan repayments were relatively low in Tumby Bay SLA at \$AUD800 compared with \$AUD867 and \$AUD1,018 for the Eyre region and South Australia respectively.

6.0 IMPACT ASSESSMENT

This Section provides an assessment of the potential effects of the Port on the existing environment and social surrounds. Where applicable, impacts are assessed for the construction, operational and decommissioning phases of the Port. A qualitative environmental and social impact risk assessment is provided in Section 7.2, and Section 7.2 also includes mitigation and monitoring measures.

6.1 Climate Change and Greenhouse Gas Emissions

Potential impacts of climate change on the Project during construction, operation and decommissioning are likely to be similar for all phases of the Project as they typically relate to temperature, rainfall, sea level and ocean wave changes and would continue beyond the completion of the decommissioning phase. The potential impacts common to all phases of the Project activities include the following:

- Temperature increases could stress or change the ecology located at the Port site.
 - This impact is expected to be monitored, in part, through a marine monitoring program primarily focussed with measuring impacts generated by the Project. However this should also be able to signal any stresses attributable to this quality.
 - Terrestrial ecology at the site is highly modified. Revegetation and rehabilitation works proposed as part of Port development would be monitored for planting success and maintenance, refer Section 5.9 and 7.3.7.
- Variability of rainfall may cause flooding, vegetative stress or reduction in captured rainwater volumes for use on-site could occur should rainfall decrease.
 - Where native vegetation remains or is replanted, it is expected these are somewhat hardy species able to adapt to such reduction in rainfall. Revegetation and rehabilitation works proposed as part of Port development would be monitored for planting success and maintenance, refer Section 5.9 and 7.3.7.
 - Should rainfall decrease, operational demands would be met through other sources including SA Water sources and Stage 2 desalination development.
- Potential inundation during severe storm events through the combined effects of sea level rise, storm surge, and ocean waves.
 - This has been redressed primarily through site location and design. The Tumby Bay (DC) Development Plan defines a 100 year ARI as the level of risk for storm surges. This includes consideration of potential climate change related variations. The site design complies with the 100 year ARI risk both from jetty and surface water design perspectives, refer Section 4 and 5.1.
 - The Project is designed for zero stormwater discharge off site with a 100 year ARI storm. This means that the Project would be able to capture all water received under a 100 year storm and avoid inundation, refer section 6.3.

- The jetty and conveyors are located on a raised portion of the coast that is not likely to be inundated associated with potential sea level rise or storm surge from climate change contributions.
- Potential seabed disturbance, coastal erosion, recession and vulnerability brought about by variations in offshore wave climate such as large wave events or changes in wave direction.
 - Sediment transport modelling has predicted minimal effects on beaches in the local area due to the Project's presence based on actual site wind and wave data, refer Section 6.12.
- During construction and operational phases, working conditions may become increasingly hostile due to temperature increases.
 - Construction would be undertaken in the short term, however the general potential for heat stress on all work sites is always a risk. This would be redressed through appropriate occupational health and safety (OH&S) guidelines for the Project.

6.1.1 Potential Greenhouse Gas Impacts

This Section describes sources and levels of greenhouse gas (GHG) emissions during construction and operational phases of the Port. The Section also includes a discussion of potential GHG emissions savings associated with the introduction of the Project that can accommodate Cape class vessels, compared with existing product transport options.

Emissions of GHG would be generated directly by the Port. Direct sources of GHG emissions are those generated on-site as products of combustion from fixed or mobile plant and equipment and infrastructure, including vehicles and generators. Emission sources are likely to be similar within each phase, however their volume would vary (e.g., activities would reduce and cease at the conclusion of the decommissioning phase).

Greenhouse gas emissions estimates were calculated in accordance with the *National Greenhouse and Energy Reporting Act 2007* (NGER Act 2007) and associated guidelines. The NGER Act 2007 is Commonwealth legislation that requires corporations to report on GHG emissions, energy production and energy consumption if they trigger certain emissions and/or energy thresholds.

6.1.2 Construction Phase Energy Use

The range of plant and vehicles likely to be used at the Project during the construction phase are:

- | | | |
|---------------|---------------------|--------------------|
| ■ Bulldozers | ■ Land plane | ■ Boats |
| ■ Graders | ■ Front end loaders | ■ Excavators |
| ■ Water carts | ■ Crusher | ■ Generators |
| ■ Cranes | ■ Jack-up barge | ■ Welding sets |
| ■ Rollers | ■ Piling hammer | ■ Compressors, and |
| ■ Tip trucks | ■ Pile top drill | ■ Cars and trucks. |

GHG emissions were estimated based on requirements under the NGER Act 2007 for the estimation of GHG emissions from the combustion of liquid fuels for stationary energy purposes (NGER calculations are provided in Appendix O). Direct GHG emissions from these sources are estimated to be approximately 33.5 kt CO₂-e (carbon dioxide equivalents) for the construction period.

This estimate is based on the following assumptions:

- Civil construction would occur over a period of 6 months, with all equipment required for works operating 12 hours per day, 7 days per week.
- Marine construction would occur over a period of 18 months, with all equipment required for works operating 12 hours per day, 7 days per week.
- Construction of onshore structures and earthworks would occur over a period of 12 months, with all equipment required for works operating 12 hours per day, 7 days per week.
- All equipment would operate on diesel oil, with the exception of boats which would operate on heavy fuel oil.
- Fuel consumption for all equipment is 30 L/h, except for the items listed below (note: 30 l/h was selected as an average fuel consumption rate for a range of equipment):
 - Items for which fuel consumption data was available in the Caterpillar Performance Handbook (Caterpillar, 2010). Published fuel consumption rates were used for these items.
 - Site vehicles. A fuel consumption rate of 10 L/h was assumed for these.
 - Compressors and welding sets. A fuel consumption rate of 7.5 L/h was assumed for the compressors and 6.0 L/h for the welding sets.
 - Generators. A fuel consumption rate of 300 L/kWh was assumed for generators.
- Fuel use during construction works would be tracked to permit the calculation of GHG emissions in accordance with NGER reporting requirements. GHG emissions and energy consumption would be reported to the relevant authority if reporting thresholds are triggered.

6.1.3 Operational Phase Energy Use

Energy consumption during the Project operational phase would comprise generated electricity and fuel usage to power plant and equipment.

Electricity

Power for Project operations would be supplied using on-site diesel generators until mains power is constructed, with an expected maximum demand of 5 MW (during ship loading when the conveyors are running). The generators would supply power for the following:

- Ship loaders
- Conveyors, and
- Buildings and sheds (lighting, heating and cooling, dust suppression).

It is expected that approximately 2 Mt of hematite and 0.5 Mt of grain would be loaded for transportation each year. To achieve this volume, it is estimated the required energy demand would be 5 MW for approximately 10 hours per week (or 520 hours/year), and approximately 0.5 MW for approximately 158 hours per week (or 8,216 hours/year).

Annual fuel consumption and GHG emissions have been estimated to supply these energy requirements. To obtain a conservative estimate, it was assumed that power would be provided by a single 5 MW generator. However, it is noted that the use of multiple smaller generators would be expected to improve energy efficiency, and reduce overall GHG emissions from this estimate. It is further noted electricity supplied from the grid would be more energy efficient, and therefore generator use is considered a worst case scenario estimate.

Based on typical fuel consumption rates¹² at the required loadings, annual fuel consumption is estimated to be approximately 1,990 kL. Annual power usage and fuel consumption calculations are provided in Table 6-1:

Table 6-1: Annual Power Usage and Fuel Consumption for Generator Use During Operations

Generator Capacity		Annual Operation	Annual Power	Fuel Use	
%	MW	Hours	MWh	L/MWh	kL/year
100	5	520	2,600	260	675
10	0.5	8,216	4,108	320	1,315
Total			6,708	-	1,990

Based on NGER guidelines, the annual GHG emissions resulting from fuel combustion for electricity generation is estimated to be 5.34 kt CO₂-e (calculations are provided in Appendix O).

Grid Electricity Option

On site generation is required for the project initially however it is planned to move to the Electranet mains power at a later stage (refer Section 4.7). Greenhouse gas emissions related to supply of electricity from the network were estimated to be 4.83 kt CO₂-e per annum, a decrease of 9.5% compared to on-site diesel (calculations are provided in Appendix O).

Fuel Usage for Mobile Plant

Fuel use by mobile plant during the operational phase has been estimated at approximately 2 kt CO₂-e per annum, based on the following assumptions:

- Equipment during the operations stage would include a bulldozer, water cart, front end loaders and trucks.
- All equipment would operate 12 hours per day, 7 days per week (note: though the Port would be operational 24 hours a day, all equipment would not be operating continuously – except whilst ship loading – therefore, this assumption is appropriate).
- Fuel consumption for all equipment is 30 L/h, except for the items listed below (note: 30 L/h was selected as an average fuel consumption rate for a range of equipment):

¹² Fuel consumption rates estimated from data obtained from a supplier of diesel generators (Cummins, 2007).

- Items for which fuel consumption data was available in the Caterpillar Performance Handbook (Caterpillar, 2010). Published fuel consumption rates were used for these items.
- Site vehicles. A fuel consumption rate of 10 L/h was assumed for these.
- Fuel usage during the operations phase would be recorded to allow for annual assessment GHG emissions and impacts.

Transport of Ore and Grain

This Section estimates the GHG emissions generated by transport alternatives for ore and grain. The destination of ore and grain exported from the Port is expected to vary depending on market conditions however, the majority of ore and grain is likely to be exported to China and south Asia. As such, the location of Qingdao, China was selected to provide an “average” journey length. It was estimated that Port Spencer and Port Lincoln are separated by roughly 70 km by road or sea. The sensitivity of this distance is considered negligible compared to the estimated overland transport distances from either port to Port Adelaide and the shipping route distances to Qingdao, China. Based on this assumption the GHG and energy calculations for Port Spencer are also applied to Port Lincoln for the purposes of this assessment.

To provide a quantitative comparison of GHG emissions associated with transport alternatives for ore and grain, the following scenarios were assessed:

Ore: Annual Transport of 2 Mt

- O1: Transport ore 11,800 km by sea in Cape class vessels from the Port to Qingdao, China. This scenario represents the transport alternative provided by the Project.
- O2: Transport ore 3,100 km by road (O2a) or rail (O2b) from the Port to Darwin, then 6,300 km transport in Cape class vessels to Qingdao, China. This scenario represents the existing options currently available for the export of ore, and provides an estimate of the current GHG emissions associated with road or rail transport plus shipping from Darwin compared with shipping from the Port.
- O3: Transport ore 11,800 km by sea in Panamax vessels from the Port to Qingdao, China. This scenario was quantified to illustrate the difference in GHG emissions between using Cape class vessels and Panamax vessels. This scenario can also be applied to Port Lincoln as Centrex has development approval to use Port Lincoln for export of hematite from the Wildgerup Mine. This hematite export option is not preferred by Centrex as the best transport option due to local community concerns and sensitive port use by the fishing fleet in Port Lincoln.

Grain: Annual Transport of 0.5 Mt

- G1: Transport grain 11,800 km by sea in Panamax vessels from the Port to Qingdao, China. This scenario represents the transport option provided by the Project, as well as the current export option from Port Lincoln.
- G2: Transport grain 700 km by road from the Port to Port Adelaide, then 12,250 km transport in Panamax vessels to Qingdao, China. This scenario represents an option currently available for the export of grain, and illustrates the higher GHG emissions generated by road transport compared with shipping. This was included in the assessment for comparison purposes only.

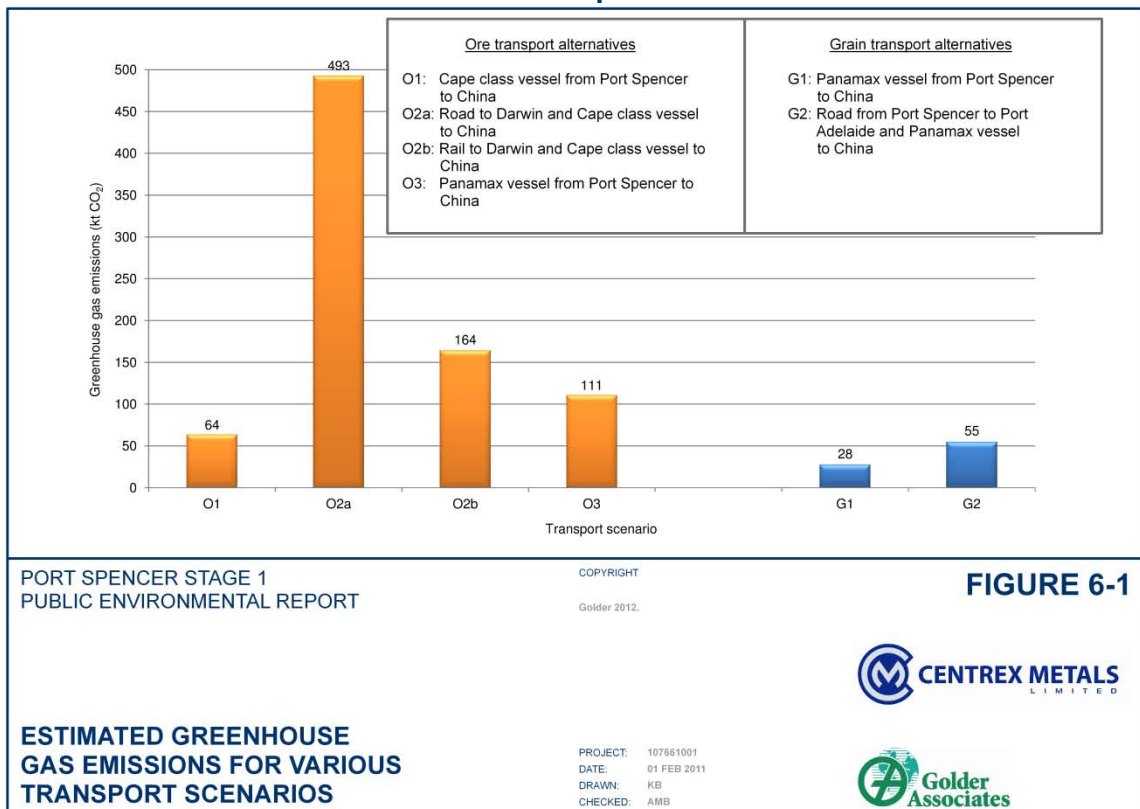
The typical GHG emissions associated with each mode of transport (sea, rail and road) are presented in Table 6-2. These values were used as a basis to quantify emissions associated with the transport alternatives.

Table 6-2: Typical GHG Emissions by Transport Type

Transport	Greenhouse Gas Emissions ¹³	Reference
Panamax vessel	4.7 g CO ₂ -e / tonne-km	NTU Athens, 2008
Cape class vessel	2.7 g CO ₂ -e / tonne-km	NTU Athens, 2008
Rail	21 g CO ₂ -e / tonne-km ¹⁴	ARA, 2010
Modern articulated truck	74 g CO ₂ -e / tonne-km	CIE, 2011

Based on the emissions rates presented in Table 6-2, GHG emissions were estimated for each transport scenario as shown in Figure 6-1. Figure 6-1 shows that the transport scenario that generates the lowest estimated transport related GHG emissions is the development of the Project, that is, option O1 for ore transport and option G1 for grain transport.

Figure 6-1: Estimated GHG Emissions for Transport Scenarios*



* It was estimated that Port Spencer and Port Lincoln are separated by roughly 70 km by road or sea. The sensitivity of this distance is considered negligible compared to the estimated overland transport distances from either port to Port Adelaide and the shipping route distances to Qingdao, China. Based on this assumption the GHG and energy calculations for Port Spencer are also applied to Port Lincoln for the purposes of this assessment.

¹³ Full fuel cycle units of g CO₂-e/tonne-km represents grams of carbon dioxide equivalent emissions per tonne of ore per km transported.

¹⁴ Unit converted based on NGER Determination guidelines.

The Project would directly load Cape class vessels with products near to their source, which would provide savings on road transport impacts and economies of scale on shipping (compared to smaller Panamax vessels, which need to travel more frequently with smaller payloads). Providing a local port to accommodate Cape class vessels, where extensive overland transport is not required, has the potential to reduce emissions generated by existing transport options by between 40% and 90% for ore, and up to 50% for grain, as shown in Figure 6-1 above.

6.2 Soils

This Section describes the potential impacts to underlying geology and soils, with reference to coastal landforms, landscape quality and erosional processes associated with the Project.

The soils of the Project area are predominantly sodic and, therefore, potentially dispersive and highly erodible. Currently, the Project area is covered by vegetation (including grasses and cultivated crops), which largely protects the soil from wind and water erosion. The Port's location on a rocky headland means that there may be a requirement for blasting for the development of building platforms and creation of the cutting where the conveyor to the jetty would be located (refer Figure 4-1). The headland facing the sea would remain undeveloped.

6.2.1 Construction Phase

Any blasting work would be undertaken by personnel certified to design and execute blasting operations, and would be carried out in accordance with all relevant codes and government and regulatory requirements. Nevertheless, the potential soil impact from blasting works is considered low. This determination is based on the following:

- Though rock removal would be permanent and irreversible, it would occur only once during construction.
- The magnitude of the rock removal is not large in relation to the entire headland and the wider area, and
- Blasting activity has very limited geographic extent, being limited to parts of the landward headland within the Project area.

During the construction phase of the Port, vegetation cover in many areas would be removed to allow for civil earthworks to commence. Consequently, areas of soil would be exposed to wind and water erosion. Potentially, large areas would be exposed to allow for the establishment of storage facilities, site drainage, establishment of construction lay down areas, upgrade of Swaffers Road, site roads and bulk excavation of site platforms (refer Figure 4-1). Potential soil impacts resulting from the removal of vegetation cover and exposure of soil are considered moderate. This determination is based on the following:

- It has limited geographic extent, being limited to the Project area; however, soils would potentially be exposed over the 48 ha portion required for stage 1 during construction.
- It would occur over the medium term, lasting the entire construction phase of approximately 18 months.
- It would occur regularly during the construction phase, particularly during rainy and windy weather, and

- Removal of topsoil and exposure of the dispersive subsoil would be reversible following rehabilitation and revegetation.

Impacts to Rogers Beach during the construction phase are not expected to be significant given the beach is not in the Project disturbance footprint. However, potential impacts to the beach may occur from access by Project personnel and unauthorised vehicles during construction when more people would be in the area. Private access to the beach would be maintained.

The potential exists for some soils to be contaminated during the construction phase of the Project. The sources of potential contamination would primarily be from refuelling of plant, bulk storage of fuel for the plant, storage of hazardous substances and dangerous goods required for construction, and sewage and wastewater generated from the construction accommodation. Impacts resulting from contamination of soil are considered to be of low significance. This determination is based on the following:

- The magnitude of the potential contamination would, for all intents, be quite limited due to the quantities of potential contaminants involved.
- It has limited geographic extent, being limited to the site of a particular spill given that stores of bulk products would be in appropriately bunded facilities.
- It would occur over the immediate term, limited to a few days while the spill is cleaned up.
- It may occur infrequently during the construction phase., and
- Clean-up and removal of contaminated soil would make it fully reversible.

6.2.2 Operational Phase

Once the Project is in operations phase, the following sources of impacts to geology and soils may potentially arise:

- Inadequacy of rehabilitation and revegetation leading to areas exposed to wind and water erosion.
- Spillages of fuel and other substances during day-to-day operations.
- Inadequate treatment of sewage and waste water generated from Project facilities, with untreated water escaping to land., and
- Spillage of hematite ores and dust from the storage shed and ship loading, which may result in elevated levels of iron in the surrounding soils.

Potential impacts to geology and soils are considered to be limited, and largely not significant. This determination is based on the following:

- The magnitude of the potential impacts would, for all intents, be quite limited.
- Potential impacts would have limited geographic extent.
- Potential impacts would mostly occur over the immediate to short term.
- Potential impacts may occur infrequently, and
- Potential impacts are mostly fully reversible.

A potential impact on Rogers Beach may result from the berthed ships at the proposed wharf during operations. These ships may act as a wave screen and, in turn, may affect longshore drift, the process driving the geomorphological processes maintaining Rogers Beach. This potential impact has been addressed in Section 6.12.

6.2.3 Decommissioning Phase

Potential impacts to the geology and soils of the Project area during the decommissioning phase would largely be similar to those expected during construction phase. It is expected that these impacts would not be significant. However, given the dispersive nature of the soils in the Project area, as identified during the construction phase above, impacts resulting from the exposure of soil may become significant if not managed and monitored properly.

6.3 Surface Water

A surface water conceptual design and management strategy analysis for the Project was conducted during 2011. The full report (refer Appendix F) includes a surface water conceptual design and management strategy that includes:

- Existing conditions surface water site investigation.
- Desktop review of relevant stormwater regulatory and management guidelines.
- Stormwater runoff hydrology:
 - 100-year Annual Recurrence Intervals (ARI) for existing conditions, and
 - 10-year and 100-year ARI for proposed conditions.
- Conceptual design of stormwater improvements for proposed conditions:
 - On-site stormwater extended detention basin, and
 - Off-site diversion channels, culverts and related stormwater improvements.

The results of the hydrologic analysis were used to identify potential impacts to surface water during the construction, operational and decommissioning phases of the Project. Surface water design is such to limit stormwater to site, and divert surface water around the site.

6.3.1 Surface Water Proposed Conditions

The *Environment Protection Act 1993* and the *Environment Protection (Water Quality) Policy 2003* lists the following environmentally significant activities and pollutants that are applicable to the Project:

- Petroleum and chemical
- Chemical storage and warehouse facilities
- Material handling and transportation
- Bulk shipping facilities
- Agricultural crop products, and
- Rock, ores, minerals.

The Policy lists pollutants in Schedules 4 and 5. Contaminated stormwater is defined as stormwater that “...is contaminated by a pollutant listed in Schedule 4 or any material that could be reasonably prevented from entering the pipes, gutters and other channels used to collect and convey the stormwater.” Potential listed pollutants per Schedule 4 applicable to the Project operation could include, but are not limited to, the following: air conditioning or cooling system wastewater, building wash water, condensate from compressors, fire sprinkler test water, oil, grease or lubricants, rubbish, petroleum products and wastes listed in Part B of Schedule 1 of the *Environment Protection Act 1993*. The proposed stormwater design would contain stormwater onsite.

The surface water study includes a conceptual design of flood improvements. The conceptual design is based on the proposed marine port arrangement and proposed conditions storm runoff analysis. Figure 6-2 shows the proposed surface water conditions catchment, Project boundary and summary of existing conditions storm runoff for the 100 year storm event. Figure 4-2 shows the location of flood control and runoff diversion channels and the off-site catchment boundaries that report storm runoff to the channel reaches. An important aspect of the conceptual design is the outfall to the flat zone that lies immediately to the west of Rogers Beach. This concept mimics the existing condition drainage pattern at this location and would promote the distribution of storm runoff to Rogers Beach in the same manner as existing conditions. This would also mimic the sedimentation and groundwater interaction at this location.

The diversion and flood control channels diverting runoff around the Project area emphasise low velocity design, where feasible. Low velocity flow is utilised in Reaches 1, 2 and 3 using open channel drop structures to decrease the slope of the channels. The resulting design allows for the use of vegetated earthen channels.

A reinforced channel is designed using gabion mattress reinforcement where channel slopes, high flow velocities and site civil constraints dictated a reinforced channel. Energy dissipation is achieved using a free jump energy dissipation basin design. The design concept at the outfall to the flat zone adjacent to Rogers Beach incorporates the following features:

- Low flow velocity earthen vegetated channel parallel to the Rogers Beach public access road.
- Culverts under the access road are sized for the smaller and more frequent 10 year storm event., and
- Storm events greater than 10 year ARI would flow over the public access road.

The energy dissipation basin and the low velocity channel in Channel Reach 4C, next to the public access road, can allow for sediment to settle out from the smaller and more frequent storm events and be removed as part of the Project management and operation.

The Port stormwater runoff management would be managed and mitigated with the 136 ML extended detention basin. The extended detention basin would be operated in conjunction with Project stormwater reservoirs. This would allow the extended detention basin to be drained within 72 hours of a storm event allowing the basin to maximise storage capacity to mitigate the capture and detention of storm runoff. The storm runoff from the Project is to be contained on-site and managed using an extended detention basin sized for the 100 year storm event. Captured runoff from the Project area is to be harvested and reused on-site.

Table 6-3 summarises the results of the storm runoff rates used in the conceptual design for the proposed conditions. Table 6-4 summarises the comparison of storm runoff rate and volume for the existing and proposed conditions at the flat zone adjacent to Rogers Beach.

Table 6-3: Proposed Conditions Catchment Runoff for 100 Year Storm

Channel Reach	Catchment	Area (ha)	Runoff Peak Flow (m ³ /s)
1	1	357	21
2	2	252	45
	3	29	
3	4	9	46
4	5	105	56
Total		752	N/A

Table 6-4: 100 Year Storm for Existing vs. Proposed Conditions at Rogers Beach

Condition	Peak Flow (m ³ /s)	Total Runoff Volume (ML)
Existing Conditions (Existing)	68	304
Proposed Offsite Diversion (Reach 4)	56	251

The proposed off-site conditions have a smaller peak flow and total volume due to the isolation of the Project catchment area runoff.

Table 6-5 summarises the stormwater flood control and storm runoff diversion channels as shown in Figure 4-2. Other stormwater channel features shown in Figure 4-2 include low flow channels, open channel drop structures, energy dissipation basin and culverts.

Table 6-5: Flood Control and Stormwater Channel Design Summary

Design	Channel Reach					
	1	2	3	4A	4B	4C
Channel Lining	Earthen Vegetated	Earthen Vegetated	Earthen Vegetated	Gabion Mattress	Gabion Mattress	Earthen Vegetated
Bottom Width (m)	3	10	11	11	11	11
Channel Side Slope (H:V)	3:1	3:1	3:1	2:1	2:1	3:1 and 2:1
Peak Flow (m ³ /s)	21	45	46	55	55	55
Flow Depth (m)	1.40	1.6	1.4	1.5	0.86	1.4
Flow Velocity (m/s)	1.9	1.9	2.1	2.6	5.1	2.1

The proposed Rogers Beach Public Access Road culverts are sized to convey a 10 year storm event. The Public Access Road is designed to overtop during the 100 year storm event. The overtopping of the Public Access Road is intended to allow the smaller, more frequent storm events to pass under the road while the larger, less frequent storm events would overtop the road. This concept is incorporated into the conceptual design on the basis of minimising the Public Access Road grading and embankment height.

The Project catchment is managed using an extended detention basin sized to contain the volume of runoff from a 100 year storm event. The catchment for the on-site condition includes portions of undisturbed catchment to the south of Lipson Cove Road and is shown as Catchment 6 in Figure 6-2. The total extended detention basin volume is estimated as 136 ML.

Potential impacts to surface water controls include:

- Build up of sediment in channels
- Exposed soils on cut slopes and earthen channel
- Erosion
- Non-stormwater discharge to surface water
- Flood control
- Spills to surface water, and
- Stormwater runoff.

6.3.2 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is a leading practice approach to planning and designing developments which integrate total water cycle management and promote sustainable use and re-use of water. The WSUD manual is a not a prescriptive tool but provides a range of opportunities and techniques that may be employed (DPLG, 2010). WSUD principles were considered in the design of this Project including:

- 1) Incorporating water resources early in the planning process:
 - Water demand estimation and surface water management have been included in early Project design and this PER.
- 2) Addressing water resource issues:
 - Centrex has commenced discussions with SA Water regarding potable water supply to the site (refer Section 4.6) and included stormwater capture and reuse as a key element of project layout design.
- 3) Applying a precautionary approach to water management:
 - Refer point 1, 2 and 4 (above and below).
- 4) Recognising water as a valuable resource:
 - Centrex has recognised the potential for stormwater reuse to reduce the requirement for overall potable water demand and included this in site design.
- 5) Recognising and implementing site-specific solutions:
 - Section 4.6 and Figure 4-2 includes a site specific design for capture and reuse of stormwater and consideration of local hydrological conditions, and
- 6) Protecting ecological and hydrological integrity: refer point 5 above and Section 7.3.5

The following summaries the WSUD measures directly relevant to the Project and how they have been redressed:

- Water supply demand reduction.
 - Demand reduction is a measure that aims to conserve water supplies. Measures to achieve this principle include; water use efficiency, landscape practices, water reuse, and water storage (DPLG, 2010).
 - The Project would collect non-potable water through the onsite drainage network (including infrastructure guttering and downpipes) for wash down of plant and equipment and fire suppression systems, refer Section 4.6.
 - The following Project water demand is estimated based on the WSUD approach to water management at the site and has considered reuse in this estimation. Due to seasonal variations actual demand for potable water may increase or decrease, however water reuse will be priority when available:
 - Approximately 1 ML/day for 10 months during initial construction period for earthworks.
 - Approximately 0.25 ML/day for following 15 months for constructions of jetty and site infrastructure, and
 - Approximately 0.25 ML/day during Port operation (see section 4.6).
- Water storage:
 - Water storage is a measure which conserves water supplies by storing water for future use. This also facilitates demand reduction. It can also serve to reduce peak flow velocities and volumes reducing; erosion, flooding and pollution (DPLG, 2010).
 - Facilities such as; an onsite extended detention pond (135 ML) and an onsite stormwater retention pond are proposed for use at the Project (see section 4.6).
- Wastewater management:
 - The purpose of the wastewater management measure is to use alternative water sources where available and to minimise wastewater disposal to the marine environment (DPLG, 2010). As previously stated, the Project would utilise stormwater as an alternative non-potable water source thereby reducing potential demand for potable water from SA Water mains supply.
 - The site design includes zero stormwater discharge off site to the marine environment from the Project area.
- Urban water harvesting or stormwater retention and drainage:
 - The Project is designed for zero surface water discharge as all stormwater is collected and reused. This reflects WSUD measures and principles to reduce water supply demand and harvesting stormwater for reuse., and
 - Rainwater from infrastructure surfaces will also be piped to stormwater retention ponds for storage and reuse.

- Sedimentation basins:
 - A sedimentation basin is a measure designed to assist in reducing flow velocities and therefore assist in the uniform deposition of sediment (DPLG, 2010). Figure 4-2 identifies conceptual stormwater management infrastructure including; the use of culverts, channel drop structures, an energy dissipation basin, on-site stormwater retention pond and a 135 ML onsite extended detention pond. This retention pond would manage surface water allowing for a 1:100 year ARI peak flow rain event and no surface water discharge off-site.
 - These modifications have included a low velocity earthen vegetated channel around the Project so off site conditions may have a slightly smaller peak flow and total volume due to the isolation of the Project area (refer section 6.3.1).

The remaining WSUD measures, with reference to the DPLG manual, were deemed unsuitable when considered in the context of the Project (DPLG, 2010). Conditions leading to this determination include; structure suitability for modifications, high groundwater levels, non-urban setting, predicted vehicle movement, limited water demand, already present open areas and large site footprint (140 ha).

The proposed Port layout achieves the desired outcomes of WSUD including:

- Maintaining natural water balance
- Reducing flood risk
- Reducing erosion of waterways
- Efficient use of water resources, and
- Reducing cost of providing and maintaining water infrastructure.

6.4 Groundwater

This Section describes the potential groundwater impacts associated with the construction, operation and decommissioning phases of the Project. A site groundwater investigation; Appendix E) indicated that the groundwater levels at the Project range between approximately 0.9 m above Australian Height Datum (AHD) and 2.3 m AHD.

The Project would not use groundwater as a water source, and it is understood there are no known groundwater users within an 8 km radius of the Project. Salinity information indicates that the uppermost aquifer is generally brackish to saline water that would be unsuitable for irrigation or potable use (Golder, 2009d).

A bore reconnaissance survey of groundwater wells constructed in the uppermost aquifer and registered with the Department of Primary Industry and Resources South Australia was conducted in 2008. The survey confirmed that those bores were not in use and registered bores had been abandoned due to poor groundwater quality and the introduction of a piped water supply to the area.

Site activities at all stages of the Port retain the potential to impact upon groundwater. There are two pathways through which contaminants could reach the groundwater from the Project:

- Through direct transmission of liquids through the underlying soils to the groundwater, and
- Through the leaching of contaminants from contaminated soils as water passes through it.

When contaminants reach groundwater, they can render it unfit for use as a resource, though it should be noted that the uppermost aquifer is generally brackish to saline water that would be unsuitable for irrigation or potable use in any case. Contaminated groundwater can mobilise contaminants over significant lateral distances, though in this case this shallow groundwater flow regime is generally towards the sea, where any impact would not be significant or indeed measureable.

Due to the site groundwater conditions and no proposed use, potential impacts are expected to be minor and limited to potential contamination from Project sources. Mitigation measures are outlined in Section 7.3.6



PROPOSED SURFACE
WATER CATCHMENT
CONDITIONS



LEGEND

- Catchment Boundary and Label
- Project Boundary
- Contour (m AHD)
- Drainage Pattern
- A=** Catchment Area, ha
- Catchment Runoff Combination Point
- Q₁₀₀=** Peak Flow Rate (m³/s)

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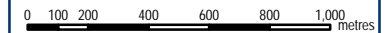
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FIGURE 6-2



6.4.1 Construction Phase

Impacts to groundwater during the construction phase may result from the following:

- Mobilisation of existing contaminants present on-site due to earthworks and the potential for the creation of preferential pathways to groundwater.
- Migration of hydrocarbons to groundwater through spills or leakage due to the presence of earthmoving and construction plant and equipment, including vehicles, compressors and diesel generators.
- Migration of chemicals and hydrocarbons to groundwater due to spills or leakage due to the storage and use of chemicals on-site, including fuels, oils, greases and solvents.
- Migration to groundwater of wastewater or treated wastewater through failure of wastewater treatment systems or designated irrigation disposal area., and
- Off-site surface water impacted by agricultural land use (such as fertiliser, herbicides or pesticides) that is captured, stored and re-used on-site may permeate to groundwater.

6.4.2 Operational Phase

Impacts to groundwater during the operational phase may result from the following:

- Migration of hydrocarbons to groundwater through spills or leakage due to the presence of site, earthmoving and construction plant and equipment, including vehicles, compressors and diesel generators.
- Migration of chemicals and hydrocarbons to groundwater due to spills or leakage due to the storage and use of chemicals on-site, including fuels, oils, greases and solvents.
- Migration of wastewater or treated wastewater to groundwater through the failure of wastewater treatment systems or designated irrigation disposal area.
- Off-site surface water impacted by agricultural land use (such as fertiliser, herbicides or pesticides) that is captured, stored and re-used on-site may permeate to groundwater., and
- Reduction in groundwater recharge due to the presence of low permeability surfaces and pavements on the site. Note that reduction in groundwater recharge would also have a positive benefit in reducing the mobilisation of any contaminants in the underlying soils.

6.5 Air Quality

This Section describes the potential air impacts associated with Project construction, operation and decommissioning phases. Air dispersion modelling was completed to assess potential air quality impacts of the Project's operations. The modelling assessment included PM₁₀ and PM_{2.5}, and estimated worst case ground level concentrations (GLC) within a radius of approximately 2.5 km of the Project area, refer Figure 6-3 and 6-4. Details of input parameters and rationale used in the modelling are provided in Figures 6-3, 6-4 and Appendix C and a discussion in Section 6.5.2.2.

The main potential air quality impacts identified for the Project are associated with emissions of particulate matter (refer Appendix C). Airborne particulate matter is defined as total suspended particulate (TSP) or classified based on particle size. PM₁₀ represents particles with an equivalent aerodynamic diameter less than 10 micrometres and PM_{2.5} represents particles with an equivalent aerodynamic diameter less than 2.5 micrometres.

The risks to human health from inhalation of PM₁₀ and PM_{2.5} have been well demonstrated, with particles in these size fractions able to pass through the nose and throat and deposit in the lower regions of the respiratory tract. TSP impacts are generally associated with nuisance settlement, as large particles rapidly settle from the air and cause amenity issues.

6.5.1 Construction Phase

Dust and other air emissions which may be generated by construction activities that have the potential to result in reduced air quality at sensitive receptors are as follows:

- Wind-borne dust from exposed surfaces, such as cleared areas and material stockpiles.
- Dust from vehicle and mobile plant movements on unsealed surfaces.
- Dust generated during materials handling required to conduct earthworks.
- Dust generated during crushing for preparation of road base. (Material removed during excavation that is considered suitable for use as a road base would be crushed and used for that purpose).
- Dust generated during blasting of rock material, which may be required as part of the bulk excavation for the Project., and
- Products of combustion from fuel use in vehicles and mobile plant. Products of combustion typically include oxides of nitrogen, carbon monoxide, carbon dioxide, particulate matter and volatile organic compounds.

6.5.2 Operational Phase

Materials handling is a key operations activity and has potential to generate dust and other air emissions, with the potential for significant dust emissions during ore and grain handling. These impacts are addressed in further detail as sources of particulate matter are identified and air dispersion modelling outcomes are presented.

The main potential air quality impact associated with the Project's operation is particulate matter emissions associated with the transport and handling of ore and grain. Ore and grain would be unloaded within covered gantries into receipt hoppers, transported to storage sheds via conveyors, stored and handled in storage sheds as required, transported to ship loaders via conveyors, and loaded into ships by the ship loaders. It is noted the proposed Port design (refer Section 4) includes covered and enclosed material handling, storage and transport equipment. The main potential sources of particulate matter emissions to air from material transport and handling are:

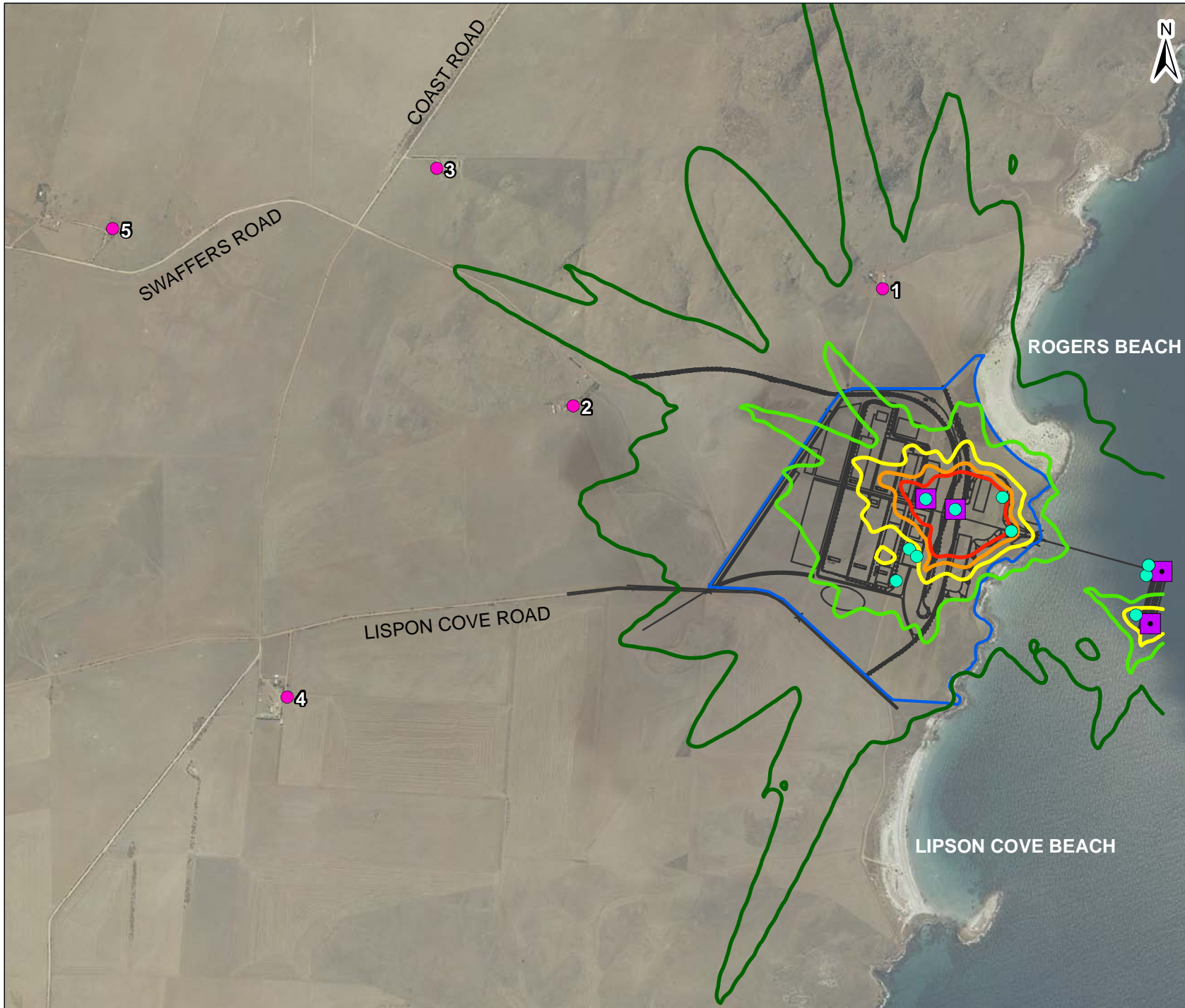
- Hematite and grain receipt hoppers
- Hematite and grain storage sheds
- Hematite and grain conveyors, and
- Hematite and grain ship loaders.

Dust emissions may also be associated with moving vehicles; however, as road train access would be via a sealed road, dust emissions associated with this activity are considered negligible.

6.5.2.1 Sources of Other Airborne Contaminants

There would also be a 5 MW diesel fuelled generator for the Project. The generator stack would emit combustion products, of which the potential contaminants of concern are typically considered to be oxides of sulphur and nitrogen (SO_x and NO_x), and carbon monoxide (CO). Due to short term nature of generator use, contaminant loads are not expected to be significant or cause negative impacts.

Products of combustion from fuel use in vehicles and mobile plant would also be present during the operational phase.



PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT
MAXIMUM PREDICTED
PM_{2.5} GROUND LEVEL
CONCENTRATION



LEGEND

- Sensitive Receptor
- Point Source
- Volume Source

PM_{2.5} Ground Level Concentration
(ug/m³ 24 hour average)

- 5 ug/m³ 24 hour average
- 10 ug/m³ 24 hour average
- 15 ug/m³ 24 hour average
- 20 ug/m³ 24 hour average
- 25 ug/m³ 24 hour average

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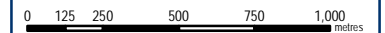
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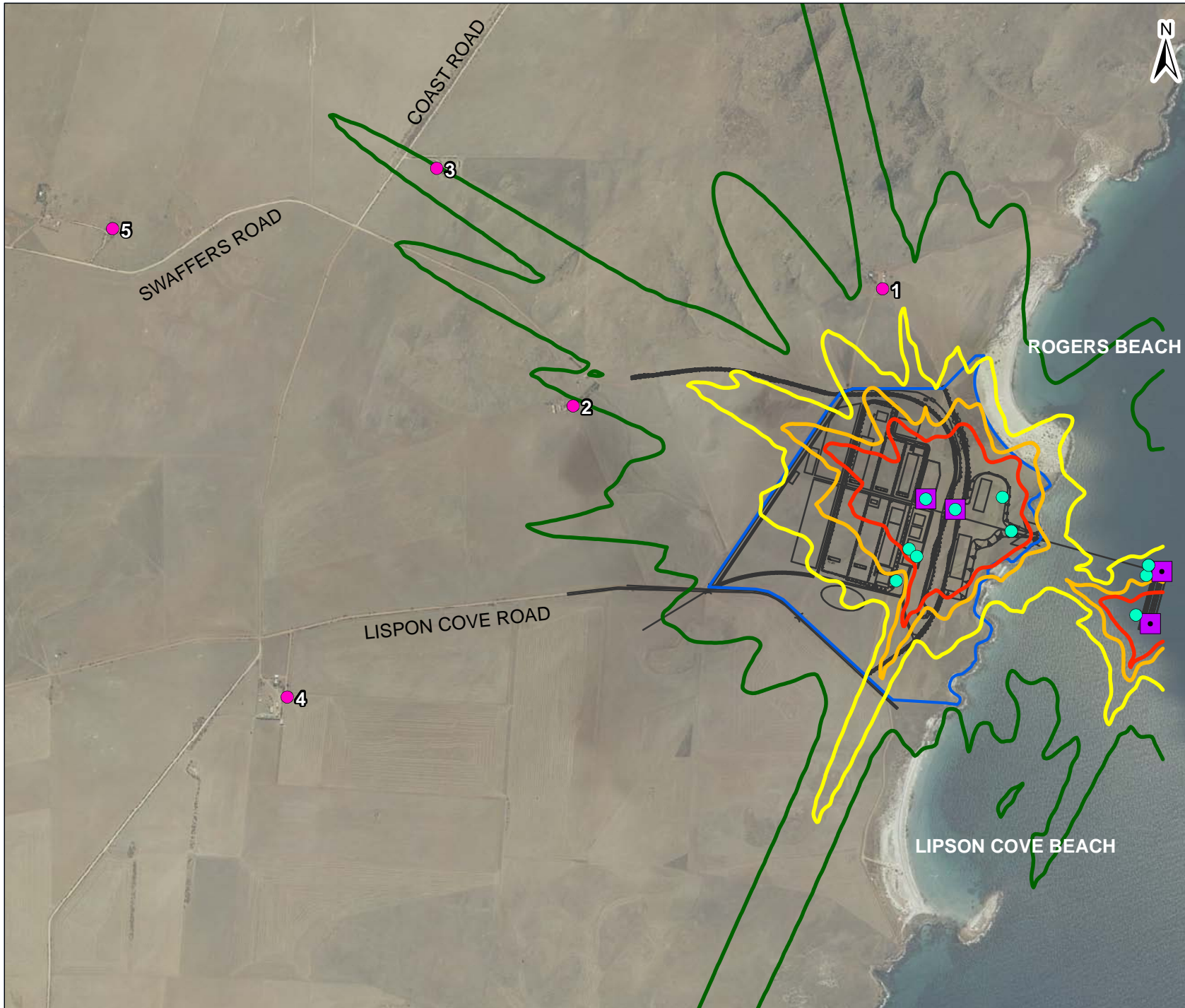
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FIGURE 6-3





PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT
MAXIMUM PREDICTED
PM₁₀ GROUND LEVEL
CONCENTRATION



LEGEND

- Sensitive Receptor
- Point Source
- Volume Source

PM_{2.5} Ground Level Concentration
(ug/m³ 24 hour average)

- 12.5 ug/m³ 24 hour average
- 25 ug/m³ 24 hour average
- 37.5 ug/m³ 24 hour average
- 50 ug/m³ 24 hour average

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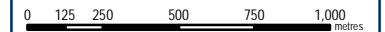


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FIGURE 6-4



6.5.2.2 Air Dispersion Modelling

The modelling assessment indicates that maximum predicted average PM₁₀ and PM_{2.5} concentrations resulting from the Project comply with the model assessment criteria (refer Appendix C) at all sensitive receptors, and are below regulated guidelines for exposure.

The air modelling assessment also considered the potential impact of the 5 MW generator. Based on experience of these types of emission sources and knowledge of the environmental setting of the Project, it was considered unnecessary to complete a fully quantitative risk assessment of this emission using a model for the following reasons:

- The generator would only be operating at peak load periodically when the conveyors are operational during ship loading (for approximately two days every two weeks) and at all other times would be operational to provide a much lower base load. The generator would therefore generally not be subject to frequent cold starts, which would normally be expected to contribute a short-term increase in emission concentration.
- Given the rural setting of the Project, the background concentrations of SO_x, NO_x and CO are likely to be negligible., and
- The closest receptor is 1 km from the Project. Emissions from diesel fuelled generators rarely exceed air quality assessment criteria at this distance in areas with low background.

6.5.3 Decommissioning Phase

Decommissioning activities are not expected to result in significant air emissions. Limited material and waste handling would generate combustion product emissions through their transportation off-site. If the infrastructure is demolished, then similar impacts to that described for construction may be expected.

6.6 Noise

Noise that may be generated during the Project would be from construction activity, operational activity and vehicle movements to and from the site along Swaffers Road and Lipson Cove Road. A noise model has been completed to established predicted noise levels at various sensitive receptors around the Project, refer Figures 6-5 and Appendix G.

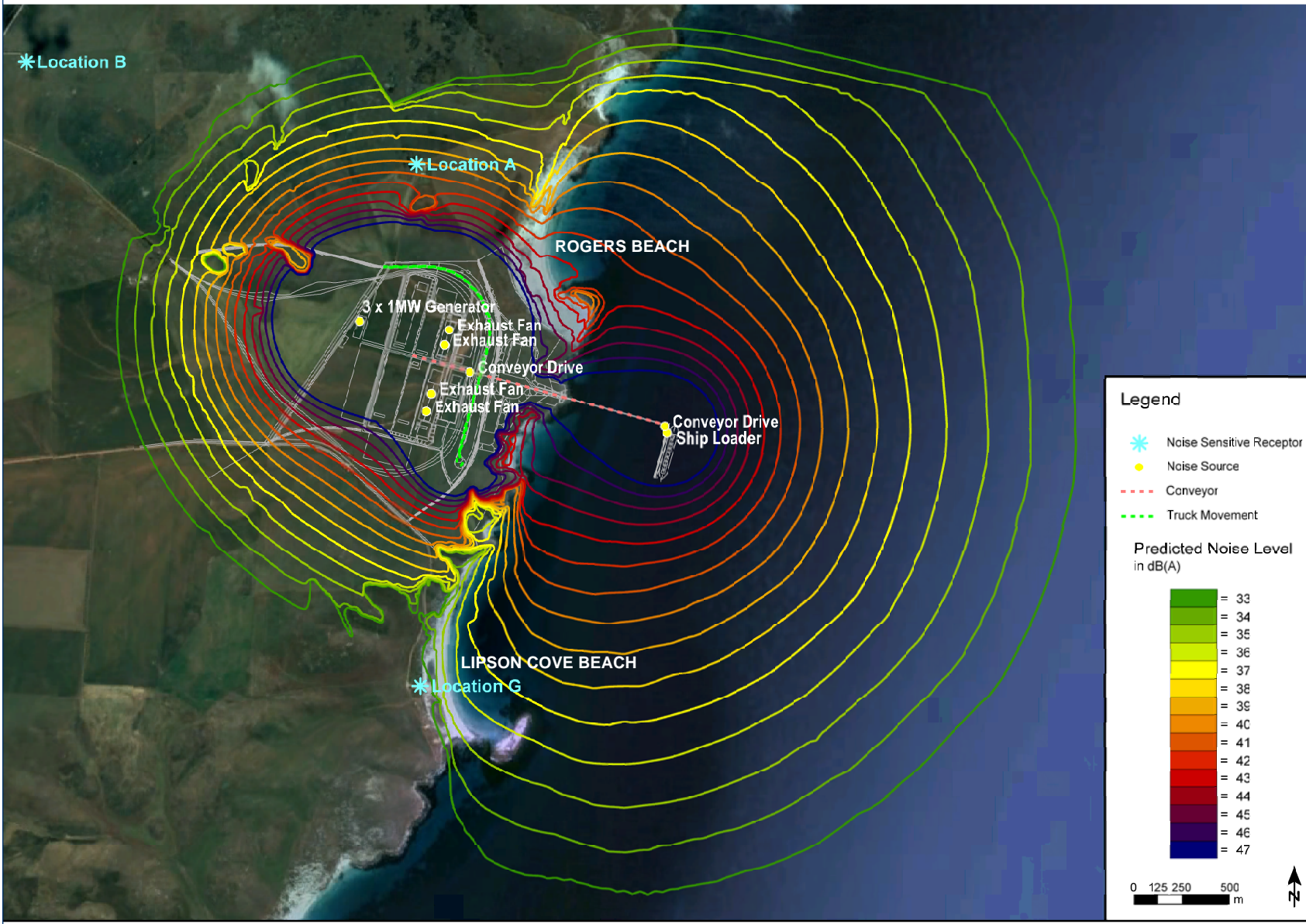
Noise assessment levels have been taken from:

- *Environment Protection Act 1993* (the EPA) and in particular the 'General Environmental Duty' of the Act, Section 25, and
- *Environment Protection (Noise) Policy 2007*.

PREDICATED NOISE
LEVELS WITH ACOUSTIC
TREATMENT



NOTE
With reference to Environment Protection (Noise) Policy 2007 and a night time maximum noise level of 40 dB(A).



Legend

- * Noise Sensitive Receptor
- Noise Source
- - - Conveyor
- - - Truck Movement

Predicted Noise Level in dB(A)

Green	= 33
Light Green	= 34
Yellow-Green	= 35
Yellow	= 36
Orange-Yellow	= 37
Orange	= 38
Red-Orange	= 39
Red	= 40
Dark Red	= 41
Red-Orange	= 42
Orange	= 43
Yellow-Orange	= 44
Yellow	= 45
Light Green	= 46
Green	= 47

0 125 250 500 m

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FIGURE 6-5



6.6.1 Construction Phase

The construction of the Project and the upgrade of Swaffers Road would comprise activities which have the potential for short term adverse noise and vibration impacts on the surrounding noise-sensitive locations. Under Schedule 1 of the *Environment Protection (Noise) Policy 2007*, if noise levels for construction activities are not greater than 45 dB(A) at noise-sensitive locations, the Policy allows activity to occur at any time provided that ‘all reasonable and practicable measures’ are taken to minimise the noise from the activities and its impact on the surrounding areas. For noise levels higher than 45 dB(A), construction activity would be restricted to Monday – Saturday (not including public holidays) and between the hours of 7.00 am and 7.00 pm.

Detailed construction activities and equipment to be used are yet to be finalised, but typical construction activities have the potential to generate high levels of noise. Therefore reasonable and practical noise reduction measures have been identified through a central construction framework that would be a central element in both securing compliance with environmental legislation and minimising impacts on the community, refer Section 7.3.4.

6.6.2 Operational Phase

6.6.2.1 Plant and Equipment Operations

Assessment Criteria

The *Environment Protection (Noise) Policy 2007* provides two tests for a noise source, with the most appropriate noise test for the Project being the comparison with goal noise level. Goal noise levels are determined based on the Development Plan zoning in which the noise source (the Project) and the noise - sensitive locations (i.e. the residences and the Lipson Cove campsite) are located, and the land uses that are principally promoted by those zones.

The Project and the noise-sensitive locations are all located within either a ‘General Farming’ zone or a ‘Coastal’ zone of the District of Tumby Bay Development Plan (Tumby Bay District Council, 2011). Based on the zoning of the area, the development nature of the site, and the application of a 5 dB(A) penalty for noise character (i.e., ‘annoying’ characteristics of tone, impulse, low frequency and modulation, in this case truck movements), the applicable ‘goal noise levels’ for noise from operational activity at the Project to the surrounding noise-sensitive locations are as follows:

- 47 dB(A) during the daytime (7.00 am – 10.00 pm), and
- 40 dB(A) during the night-time (10.00 pm – 7.00 am).

It is intended that operations would occur on a 24-hour basis, therefore it is the night-time goal noise level 40 dB(A) that is more relevant.

The predictions have been made based on the following:

- Noise sources:
 - Road train movements around the Project area
 - The unloading of grain and hematite within fully enclosed buildings
 - Ventilation and dust control equipment associated with the unloading and storage areas
 - The operation of front end loaders within the grain and hematite storage sheds

- Operation of enclosed conveyor belts and associated conveyor drives
- A ship at berth
- Operation of a ship loader, and
- Operation of on-site power generators.
- Assumed level of activity in a 15-minute period (the default assessment period under the *Environment Protection (Noise) Policy 2007*):
 - 2 B-Triple trucks moving continuously around the Project area
 - A ship being continuously loaded at the jetty
 - A truck unloading at the grain in-loading shed
 - Continuous operation of a conveyor
 - A conveyor drive at the sampling station and a conveyor drive at the end of the jetty
 - A front end loader in the grain storage shed
 - A front end loader in the hematite storage shed
 - Two exhaust fans and associated filters on the grain storage shed
 - Two exhaust fans and associated filters on the hematite storage shed, and
 - Three 1MW diesel generators at the “switchyard and generator” location (refer Figure 4-1).
- Sound power levels and noise levels presented in Appendix G have previously been measured from road train movements at various speeds under both loaded and unloaded conditions.

Predicted Noise Levels

Based on noise modelling results with no specific acoustic treatment in place, the noise from operational activity of the Project is predicted to exceed the 40 dB(A) goal noise level at one residence immediately north of the Project area. The noise would predominantly come from three diesel generators towards the centre of the site and is predicted to account for 44 dB(A) of the predicted overall 45 dB(A) noise level.

Upon application of acoustic treatment options (refer Section 7.3.4) noise modelling showed noise levels were not predicted to exceed the 40 dB(A) goal noise level.

6.6.2.2 Vehicle Movement

Department of Transport, Energy and Infrastructure (DTEI) *Road Traffic Noise Guidelines 2007* specify outdoor noise level targets averaged over a specified period as:

- 55 dB(A) during the daytime (7.00 am – 10.00 pm), and
- 50 dB(A) during the night-time (10.00 pm – 7.00 am).

The assessment of noise from vehicles on Swaffers Road and Lipson Cove Road has been based on the following:

- A total of 280 road train movements (140 movements for hematite trucks and 140 movements for grain trucks) along Swaffers Road per day.
- An assumption that these road train movements would be equally distributed across the 24-hour period. That is, approximately 12 movements per hour along Swaffers Road, over each hour of the day.
- A total of 30 passenger vehicle movements along Lipson Cove Road per day (refer Appendix G).
- An assumption that one third of these passenger vehicle movements could occur in a single hour., and
- A speed limit along both roads of 100 km/h.

The closest residences to Lipson Cove Road are approximately 200 m from the road (locations D and E as shown in Appendix G). This distance alone is sufficient to ensure that vehicle movements along Lipson Cove Road would achieve target noise levels and no mitigation measures are necessary.

Potential noise from Swaffers Road was assessed. Predictions were made from noise levels taken from previous studies on 'super triple' road train movements near Ceduna. This included the following:

- Trucks moving at 'low speed' (approximately 40 km/h) on sealed roads
- Trucks moving at 'high speed' (approximately 80-90 km/h) on sealed roads, and
- Trucks moving at 'high speed' on unsealed roads.

For each at the above scenarios, measurements were conducted for trucks travelling at constant speed, both loaded and unloaded trucks, and at various distances from the road, as well as the measurement of noise from deceleration and acceleration from an intersection.

The predictions are based on an average of 12 truck movements per hour, 6 trucks loaded and 6 non-loaded trucks. There is no difference between daytime and night-time predictions as movements are assumed to be constant throughout a 24-hour period. Weather conditions were also taken into consideration. Predictions have been made of the noise from truck movements along Swaffers Road to each of the residences along the road (locations B and C in Appendix G). The predicted noise level at location C exceeds the 50 dB(A) night-time target level.

6.6.3 Noise Effects on Fauna

Fauna in the areas around the Project, Swaffers Road, and Lipson Cove Road are exposed to noise and vibration from existing sources such as vehicle movements along the roads and the Lincoln Highway, and agricultural activity (such as the movement of tractors and harvesters) on private land. With the Project in place, noise and vibration would be at levels that are of a similar order to these existing sources.

6.7 Traffic

The main traffic movements to and from the Project would be the transportation of hematite and grain to storage facilities at the Port, as well as construction traffic over a 24 month period. Approximately 30 staff are expected to be on-site once the Project is operational.

A study was undertaken to assess the impacts of the additional number of vehicles on the road due to the Project. These projections and the predicted impact on the road network can be found in the report presented in Appendix H. The number and type of vehicle movements assumed for the assessment include worst case scenarios and are:

- Grain Delivery Traffic Movements

It is anticipated there would be 40 deliveries per day (80 vehicle movements in total) based on one million tonnes of grain delivered to the site over a 12 month period, seven days a week. The assessments have been undertaken with the expectation that 80% of grain transportation would be by road train, and the remainder on either semi-trailer, or truck or trailer combinations, totalling approximately 29,000 movements (in and out of the site) per year.

It is anticipated a 60,000 tonne facility would store grain at the Port. The balance of grain would be stored at other locations across the Eyre Peninsula and transferred to the Port in time for the next ship, to maintain a constant flow of grain and avoid peaks over a short period of time.

It is anticipated the majority of the deliveries would originate in the north or north-west of the Eyre Peninsula, with the remainder from the south such as Tumby Bay.

- Hematite Ore Delivery Traffic Movements

Assessments are based on hematite ore delivery being undertaken by road train. It is anticipated there would be 70 deliveries per day (140 vehicle movements in total) based on two million tonnes of hematite ore delivered to the site over a 12 month period, seven days a week.

- Passenger Traffic Movements

There are expected to be up to 30 people working on site and therefore a worst case scenario is 60 to 75 vehicle movements per day on Lipson Cove Road, based on each person travelling to site as a single occupant, and allowing for some additional trips during the day.

- Construction Traffic

Construction of the Project is anticipated to be carried out over a 24-month period. The construction workforce is anticipated to range from 50 to 250 people on-site at any one time, with the intent that the majority of the workforce is accommodated in local towns and transported to site in buses, rather than single occupant vehicles, although it would be expected there would still be some component of this type of travel.

Construction traffic is therefore expected to consist of up to 20 trucks per day, three buses and ten light vehicles, undertaking one trip in and one trip out each per day. In a worst case scenario where the entire workforce chose to drive in single occupant vehicles there would be a maximum of 250 vehicle movements per day, though this is unlikely to eventuate.

6.7.1 Proposed Site Access Arrangements

All heavy vehicle access would be via the designated Swaffers Road haul road and would enter the Project via a controlled access gate and the intersection of Swaffers Road and Coast Road.

Light vehicles, including light commercial vehicles, would access the site via Lipson Cove Road on the southern side of the Project.

In terms of the transport of hematite from Wilgerup mine to the Project, Centrex is currently considering two route options:

- Route 1 brings the transport onto the Lincoln Highway to the north of Port Neill and then south to Swaffers Road, linking through to the Port. Route 1 is shown in Figure 1 of Appendix H.
- Route 2 uses the Tod Highway, west of the mine site near Murdinga, travelling south to Cummins, then travelling east via Bratten Way to the Lincoln Highway at Tumby Bay, before proceeding north along the Lincoln Highway to access the site. Route 2 is shown in Figure 2 of Appendix H.

6.7.2 Potential Impacts

As all heavy vehicle movements would be via Swaffers Road, this is expected to place pressure on the Lincoln Highway / Swaffers Road junction, which currently has few turning movements, particularly by heavy vehicles. There is also potential would for a significant increase in the usage of the Lincoln Highway / Lipson Cove Road junction if all workers drove to the Project in individual vehicles.

Lipson Cove Road is used by local landowners and commercial vehicles, as well as some tourist vehicles to the coast. It would be planned that a large proportion of construction workers would travel to site by bus and during operations it would be expected the reduced workforce numbers would likely drive to site themselves. Based on a 2011 traffic survey Lipson Cove Road currently experiences an average of 52 vpd, with 10% of those being commercial vehicles. During operations phase Lipson Cove Road is expected to receive up to an additional 60 to 75 vpd based on 30 people working on site. This increase is expected to be condensed with shift changes at the Project. Traffic movements are not expected to impede or congest landowner, commercial or tourist use of Lipson Cove Road or access to Lipson Cove.

Both junctions have been assessed using traffic analysis software, based on the existing junction arrangements, where there was no turning lane. There is no need for an upgrade from a traffic efficiency perspective; however, improvements are suggested in terms of road safety. A discussion of suggested road upgrades / treatments is provided in Section 7.3.11.

6.8 Waste and Materials

Each of the key Project stages has the potential to generate waste materials and consume resources. The objective of the impact assessment of waste and materials is to identify strategies to be implemented to minimise the Project's environmental impacts and reduce demand upon natural resources. This assessment considers how principles within the draft South Australian Waste Strategy 2010 – 2015, including 'to avoid and reduce waste' and 'to maximise the value of our resources' can be applied to this Project. To achieve this outcome, likely waste streams have been identified, measures to mitigate their environmental impact have been assessed and opportunities where demand upon natural resources can be reduced have also been included.

A procurement policy would be developed by Centrex to encourage purchase and use of materials with recycled content, minimised packaging and materials that can be recycled at their end of life. Contractors and suppliers would be expected to reflect policy requirements in their procurement activities. This supports reuse, waste avoidance and reduction principles as described in the draft South Australian Waste Strategy 2010 – 2015.

The site includes consideration of reuse options in the current design. It is intended that, spoil generated by site earthwork cut and fill activities would be reused during construction for roads and other site civil works to minimise the use of virgin materials. Infrastructure will be primarily composed of steel material, which is recyclable at end of life and typically contains recycled content. At least 50% of all steel produced is produced from recycled product (OneSteel, 2010). These examples demonstrate the Project's support for waste avoidance and reduction principles as described in the draft South Australian Waste Strategy 2010 – 2015.

Uncontrolled release of any waste from the Project is illegal and would result in a potential adverse environmental impact, the scale of which would depend upon the type and quantity of waste released. Therefore, the types of waste likely to be generated have been considered in the context of construction, operational and decommissioning phases of the Project and are identified below. Likely quantities of waste to be generated have not been estimated for the Project since detailed design has not yet been completed.

6.8.1 Construction Phase

The construction phase is likely to generate the following waste streams:

- Topsoil
- Excavated subsoil and rock
- Packaging and off cuts from construction materials
- Mixed waste comprising kitchen and general waste from temporary buildings
- Oil and air filters from maintenance of plant and equipment
- Sewage from ablutions blocks, and
- Stormwater captured from the catchment.

6.8.2 Operational Phase

The operational phase is likely to generate the following waste streams:

- Packaging from warehouses
- Mixed waste comprising kitchen and general waste from office buildings and maintenance sheds
- Minor volumes of chemical and fuel waste
- Oil and air filters from maintenance of plant, equipment, the switchyard and generator
- Sewage from ablutions blocks
- Ballast water from ships
- Stormwater captured from the site catchment, and
- Shipping activities involving the docking and loading of cargo vessels which sail in foreign waters.

The following waste streams are typically produced from shipping activities:

- Material used to pack or stabilise cargo
- Galley and food waste
- Human, animal or plant waste, and
- Refuse or sweepings from the holds or decks of vessels.

Pursuant to the Commonwealth *Quarantine Act 1908* and associated legislation, discharge or removal of waste from an overseas vessel at a port in Australia is prohibited. Therefore, waste from ships (solid waste, black water or grey water) would not be accepted at the Project.

6.8.3 Decommissioning Phase

The decommissioning phase is likely to generate the following waste streams:

- Fuels, oils and other chemicals stored on-site, and
- General waste from workers.

6.9 Terrestrial Ecology

The majority of vegetation within the Project area is highly modified and does not possess substantially intact strata of native vegetation. Paddocks under wheat cultivation or left fallow were dominated by agricultural or weed species, with no significant trees present. All remnant native vegetation communities and associations that occur within the Project area are disturbed or degraded with weeds and invasive species making up 33% of the species composition (refer Appendix I). No rare and/or threatened species were located within the Project area and are considered unlikely to occur. The Shore Westringia Tall Open Shrubland is protected by a proposed development exclusion zone that includes Rogers Beach. The nitre bush tall Open Shrubland that is restricted to the clay pan immediately inland from Rogers Beach is highly degraded and of low conservation value, and this area provides refuge for rabbits that are protected by the nitre bush thickets. Removal of nitre bush in this area and the destruction of the rabbit warrens would improve the overall biodiversity value of remnant coastal zone vegetation. The remnant Low Shrubland vegetation association that is confined to the coastal cliff top is of regional conservation importance due to the extent of historical vegetation clearance in the region. Fauna can be particularly concentrated in areas where native vegetation remains, however the Project area did not include significant native fauna species.

6.9.1 Construction Phase

The Project infrastructure would be located primarily within the area of the site that has historically been cleared of native vegetation, (the fallow paddocks), thereby avoiding to the extent possible the need to clear remnant native vegetation and limiting disturbance of remnant vegetation during construction. Clearance of native vegetation would be restricted to the construction of the conveyer and jetty infrastructure across the cliff top coastal zone and the construction of the haul road across tall open shrubland within the claypan immediately west of Rogers Beach. The construction of the haul road and ancillary infrastructure along Swaffers Road would also require road widening necessitating removal of a narrow corridor of highly degraded native vegetation, with the majority of the roadside verge comprised of weed species that is bound by areas under cultivation. Shore Westringia Tall Open Shrubland that occurs within the dune field associated with Rogers Beach would be protected by a proposed development exclusion zone.

6.9.1.1 Native Vegetation Clearance

Parts of the Project footprint occur within areas of Low Shrubland and Tall Open Shrubland communities, Figure 6-6, mapped by the Department of Environment and Heritage, which were ground truthed and refined through the flora survey:

- 0.77 ha of *Enchylaena tomentosa* (ruby saltbush), *Maireana brevifolia* (yanga bush) Low Shrubland over *Triodia irritans* (Porcupine grass) on the coastal strip would be removed to make way for the construction of the conveyer and jetty infrastructure.
- 2.01 ha of *Nitraria billardierei* (dillon bush) Tall Open Shrubland over *Tecticornia* sp. (samphire) confined to the clay pan behind Rogers Beach, would be removed for the construction of the public access road, haul road and the future rail line.

- The vegetation along Swaffers Road lacks a substantially intact native vegetation stratum. Upgrade of Swaffers Road to form a haul road would require widening the existing roadway, including the clearance of existing roadside vegetation that is predominantly comprised of weeds, pasture species, planted native vegetation including some non-endemic species and remnant native vegetation. The length of Swaffers Road bound by cropping land would not require vegetation clearance, while approximately 3.89 km of Swaffers Road has a band of roadside vegetation of not more than 5 m either side (10 m combined width). This roadside vegetation (both sides) constitutes 3.89 ha.
- Agricultural land lies beyond the roadside verge and does not require native vegetation clearance approval.
- While not all of this vegetated roadside verge supports native vegetation for the calculation of the SEB, in order to demonstrate commitment to improving biodiversity value, the concept that underpins the SEB process, Centrex would regard this vegetation as being native vegetation.

As a development that has been declared a Major Development under Section 48 of the *Development Act 1993* operations authorised are assessed in accordance with *Native Vegetation Regulation 5(1)(c)*. A Significant Environmental Benefit (SEB) is required under this regulation for clearance of native vegetation. A Native Vegetation Management Plan (NVMP) would be prepared that is comprised of rehabilitation, revegetation weed and pest management planning in order to outline how the goal of achieving enhanced biodiversity values at the site would be attained. This NVMP is proposed to create a SEB to offset the removal of native vegetation.

In accordance with Table 1 DWLBC (2005) a SEB ratio of 2:1 (area) would be required based upon the determination of vegetation condition located along Swaffers Road and the nitre bush Tall Open Shrubland vegetation association. A SEB ratio of 5:1 (area) would be required for the ruby saltbush low shrubland vegetation association located along the cliff top that is of regional significance. Consultation with the Native Vegetation Council may be necessary to confirm the required SEB ratio and other conditions as mechanisms by which the coastal vegetation can be enhanced through effective management practices. The proposed SEB is described in more detail within Section 7.3.7

616,000

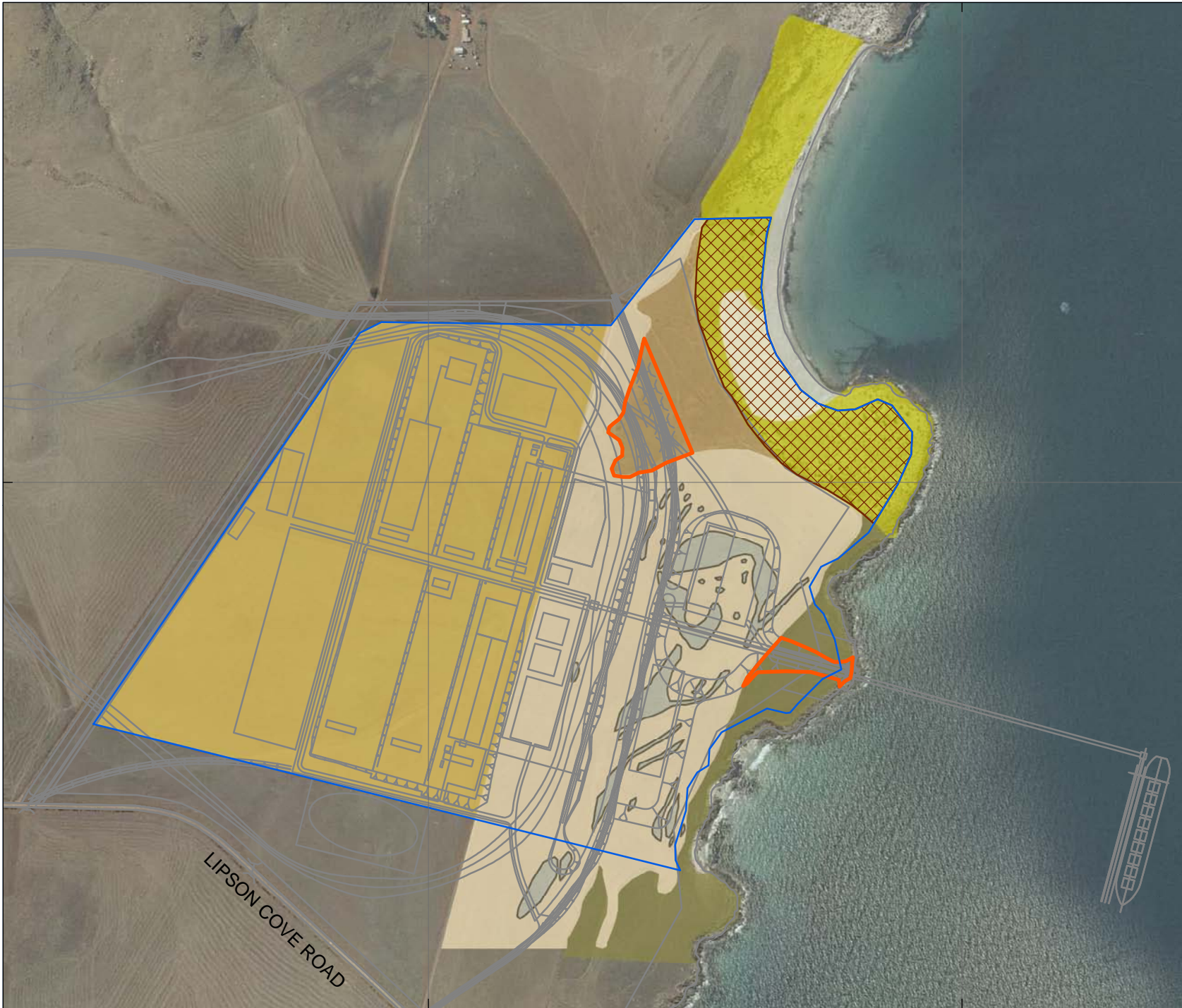
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PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT
AREA OF TERRESTRIAL
NATIVE VEGETATION
SUBJECT TO CLEARANCE

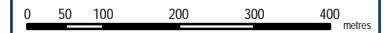


LEGEND

- Fallow Previously Tilled Land
- Low Shrubland / Open Hummock Grassland
- Sand Dune
- Tall Open Shrubland - Dillon Bush
- Tall Open Shrubland - Shore Westringia
- Wheat - Crop
- Rocky Outcrop / Stone Pile - Not Tilled
- Rogers Beach Port Infrastructure Exclusion Zone
- Vegetation Clearance Area
- Port Spencer Study Area

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SCALE (AT A4) 1:10,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 6-6



The already disturbed nature of the vegetation communities in the Project area, and the low SEB ratios confirm that vegetation clearance is not expected to be a major impact for the Project, and is of low significance. This determination is based on the following:

- The magnitude of native vegetation clearance would be limited due to the quantities involved and the low biodiversity value associated with the vegetation involved.
- It has very limited geographic extent, being limited to 15.66 ha that would be cleared only within the Project area, including the widening of Swaffers Road.
- It would occur over the short term, limited to the construction phase., and
- It is partially reversible through the creation of restoration and habitat enhancement.

The native vegetation performs an important function in stabilising the substrate along the coastal strip and this habitat could be improved by weed control and a reduction in the rabbit population.

6.9.1.2 Rare and/or Threatened Species and Communities

No rare and/or threatened flora species have been recorded in the Project area. Similarly, no threatened ecological communities occur within the Project area. Therefore, no impacts are anticipated to rare and/or threatened species or communities from the Project during the construction or operational phases. The Project area does not contain habitat that is critical or limiting (in the sense of the EPBC Act significance guidelines) for any of the fauna species presented in Table 1 of Appendix I. Therefore it is expected the Project would have no significant impact on any of the listed fauna species.

6.9.1.3 Direct Mortality of Individuals

During the clearing of vegetation and earthworks stages of the Project, individuals of species may be injured or killed. This would particularly be true of less mobile species (e.g. lizards and frogs), which may not necessarily move out of the path of machinery. Mortality may also occur on Swaffers Road due to the increase in traffic movements. The loss of those individuals from the populations is considered to be of low significance. This determination is based on the following:

- The magnitude is moderate given that local population of species would likely lose a significant number of individuals.
- The geographic extent is limited to the immediate construction footprint of the Project.
- The duration would last only last through to the end of the construction phase.
- More than likely, the effects would occur rarely, being concentrated during the early construction phase., and
- It is partially reversible given that the species affected are common to the wider area, with extensive populations that would recover following the end of construction activities, in conjunction with the habitat compensation activities planned for the Project.

6.9.1.4 Habitat Fragmentation, Edge Effects and Isolation

The construction phase of the Project would result in the clearance of some native vegetation and habitat. The Tall Open Shrubland habitat would lose approximately 2.01 ha from its south-western edge. This is an already isolated and heavily disturbed habitat. This loss in area would further increase the perimeter to area ratio and reduce the extent of the habitat. Small isolated blocks and their flora and fauna populations have an increased susceptibility to catastrophic events such as disease, fire and genetic isolation. These small blocks are also more likely to become degraded due to edge effects such as weed infestation, fertiliser drift, and higher pest animal populations at the edges.

The nitre bush Tall Open Shrubland is however highly degraded and provides refuge for rabbits and other pest animals including feral cats. The removal of habitat for these pest species coupled with pest animal control measures would produce an overall benefit to the remaining vegetation and fauna within the area. It is considered that this habitat has expanded due to vegetation clearance for agriculture, uncontrolled vehicle access, rubbish dumping and the proliferation of rabbits and has an inherently low conservation value.

The construction of the conveyor line and jetty structure would remove 0.77 ha of Low Shrubland community and habitat, and may isolate a patch of this vegetation, creating an island of habitat to the north of the conveyor line and jetty. This isolation would decrease connectivity and gene flow, which may make the habitat more vulnerable to weed infestation. Additionally, isolated, small patches are vulnerable to altered abiotic influences (i.e., changed water flow, air flows, geochemistry), which, in turn, provide conditions better suited to fast-growing weed species.

Any removal of habitat in these areas would result in a reduction in available habitat for fauna; this, in an area that is already severely depauperate and degraded and does not support significant habitats. Nevertheless, once the revegetated and habitat enhancement areas are established, fauna may move back into the area. The proposed SEB (refer Section 7.3.7 area would create a large consolidated area of native vegetation to enhance and buffer the coastal zone cliff top Low Shrubland community and restoring a low mallee community in the vicinity of Lipson Cove Road.

As such, and in light of the already disturbed nature of the habitats in the Project area, habitat fragmentation, edge effects and isolation are not expected to be a major impact for the Project, and are of low significance. This determination is based on the following:

- The magnitude of the vegetation removal would, for all intents, be quite limited due to the quantities involved and the already disturbed nature of the vegetation.
- It has very limited geographic extent, being limited to 15.66 ha that would be cleared only within the infrastructure footprint and in the widening of Swaffers Road.
- It would occur over the short term, limited to the construction phase.
- Vegetation clearance is offset through the creation of a SEB that would include restoration and habitat enhancement, revegetation and weed and pest management.

6.9.1.5 Pest and Weed Species

Numerous significant pest and weed species already occur in the Project area, notably, African Boxthorn, Onion Weed, Horehound, Feral Cats, European Fox, European Rabbits and House Mice. Other significant pests and weeds that occur in the wider area include Bridal Creeper, Boneseed, Blackberry, Gorse and European Olive.

During the construction phase of the Project there is a potential for populations of already-established weed and pest species to increase, through the creation of favourable habitat and destruction of native habitat. There is also a potential for pests and weeds not currently recorded in the Project area to colonise the area. This may occur unintentionally through propagule introduction (in the case of plants) via the importation of soil and rock from areas outside the Project area, or through soil attached to earthmoving plant.

The potential for populations of extant pests and weeds occurring in the Project area to increase and the potential introduction of new pests and weeds during the construction phase is considered to be of moderate significance. This determination is based on the following:

- The magnitude is moderate because the extant weed and pest populations may increase.
- A new species may be introduced that could increase rapidly in the Project area.
- The geographic extent has the potential to go beyond the immediate Project area, particularly if a new weed like Gorse is established along the coastal strip.
- The duration would last beyond the closure phase of the Project, with a potential for weeds and pests not only to be introduced through the day-to-day operations, but also through the potential spread and population increase in such species.
- More than likely, the introduction and spread of pests and weeds would occur rarely to infrequently., and
- It is partially reversible through the implementation of appropriate weeds and pest management procedures.

6.9.1.6 Dust, Noise and Light

There is a potential for increased atmospheric dust generated by the Project during the construction phase. That dust would be deposited on vegetation, which may reduce photosynthetic capacity, however this is limited due to the dust being washed off by rainfall or blown off by strong wind. Furthermore, there are no populations of rare and/or threatened species within the Project area that may be impacted.

Impacts from construction noise, particularly blasting, may have implications for birds breeding on Lipson Island. This is not expected to be an issue due to the distance of Lipson Island from the Project area (about 1.5 km from the jetty) and outcomes of noise modelling, refer Sections 6.6 and 6.10.

Potential impacts from light overflow from the construction phase of the Project are considered to be insignificant due to the distance to Lipson Island, existing topography and the intent to shield jetty lighting to prevent north and south light overflow.

As such, negative impacts from dust, noise and light resulting from the construction phase are considered to be of low significance and probability. This determination is based on the following:

- The distance of the Project from Lipson Island.
- The potential for species to go to the farm land surrounding the area.
- The lack of significant native fauna habitat in and around the site.
- Noise and air modelling has shown significant impacts outside Project footprint are unlikely.

6.9.2 Operational Phase

The primary impacts resulting from the operational phase of the project are expected to pertain to pests and weeds (and their ongoing management), long-term habitat alteration from changed run-off patterns and contamination from iron. Each of these, and others, are assessed below.

6.9.2.1 Pest and Weed Species

As identified for the construction phase, numerous significant pest and weed species already occur in the Project area, with others outside of the Project area. As part of the normal day-to-day operations of the Project, there is a potential to introduce new pests and weeds into the area, or for normally benign species, like House Sparrows (*Passer domesticus*), European Starlings (*Sturnus vulgaris*), or Galahs (*Cacatua roseicapilla*) (all of which occur in the area in low numbers) to have massive population increases and become pests. This is particularly the case given the grain that would be shipped from the Project, which is a potential food source, and the creation of suitable nesting habitat (together with ample food) for House Sparrows, Rock Doves (*Columba livia*) and European Starlings. It is noted that grain production is the common land use surrounding the Project and contributes to supporting the present levels of pest birds and mammals.

Furthermore, given the future grain exports from the Project, the already large house mice population in the Project area may increase. This may have follow on effects in terms of feral cats and European foxes moving into the area, or simply breeding at a higher rate due to the availability of food. Increases in populations of these predators may have implications for not only any local native fauna occurring in areas like Rogers Beach, but also potentially for bird populations breeding on Lipson Island Conservation Park. Fledgling birds from this island may find their way onto the mainland. If the populations of feral cats and European foxes are artificially high (due to the house mice populations), there is a potential for these predators to impact on those fledgling populations.

Therefore, given the above, during the operational phase, the potential impacts from pests and weeds are considered to be of moderate significance. This determination is based on the following:

- The magnitude is moderate because the extent of weed and pest populations may increase, or a new species may be introduced that could increase rapidly in the Project area.
- The geographic extent has the potential to go beyond the immediate Project area, particularly if a new weed like gorse is established along the coastal strip, or European foxes impact fledgling birds from Lipson Island.
- The duration would last beyond the closure phase of the Project, with a potential for weeds and pests not only to be introduced through the day-to-day operations, but also through the potential spread and population increase in such species.

- More than likely, the introduction and spread of pests and weeds would occur rarely to infrequently., and
- Potential impacts would be reversible through the implementation of appropriate weeds and pest management procedures.

6.9.2.2 Altered Habitat and Landscape Functioning

The wider Project area is identified as supporting very limited habitat and ecosystem value. This has been due to the long history of agricultural practices in the area that have dramatically altered the landscape and associated functions. Nevertheless, the construction of the public access road, as well as the conveyer and jetty infrastructure would not only reduce habitat and vegetation communities, it has the potential for long-term effects on landscape processes and functioning. Construction of these pieces of infrastructure would alter the current overland surface water flows that feed particularly the Tall Open Shrubland community in the north-east of the Project area. This community also sits immediately adjacent to Rogers Beach and, therefore, there is a potential for flow-on effects on the community and habitat supported in Roger's Beach. The current layout of the Project allows for a water diversion channel to direct surface flows to the north of this community. This may alter the vegetation structure and function in the long-term by altering water and nutrient flows. There is also a real possibility of less water flowing from the catchment that feeds this community given the rainwater harvesting intention of the Project.

There is also a potential for the jetty structure to subtly alter wave and wind movements that drive the dynamics of Rogers Beach vegetation community and associated habitat (refer Section 6.13). Similarly, there is a potential for hematite ore and dust spillage into this community from the haul road. This community is a salt-tolerant association that grows in a saturated soil. Such communities typically have anaerobic soil conditions. Iron, in anaerobic soil conditions is known to be toxic to plants. Therefore, there is the potential for long-term toxic effects to this community.

The isolated vegetation community that would be created through the construction of the conveyor line and jetty structure may also be impacted by altered landscape functioning. There is a potential for altered wind patterns and moisture regimes due to the altered geomorphology resulting from the cut and fill required for the conveyor and jetty.

Given the above the potential long-term impacts from altered habitat and landscape functioning are considered to be of moderate significance to significant. This determination is based on the following:

- The magnitude is high because there is a potential to completely alter the abiotic factors that influence the ecosystem dynamics driving the Tall Open Shrubland, thereby causing the degeneration, and, potentially, the ultimate demise of this community.
- The geographic extent has the potential to go beyond the immediate Project area, and affect the vegetation communities and habitats supported on Rogers Beach.
- The duration would last beyond the closure phase of the Project.
- More than likely, the effects would occur continuously., and
- It is partially reversible through the implementation of appropriate water and environmental management plans.

6.9.2.3 Revegetation, Habitat Enhancement and Compensation

Once the operational phase of the Project is complete, rehabilitation and revegetation works would be undertaken that would, in the long-term, potentially provide additional habitat in the Project area. These works would be guided through the Rehabilitation and Revegetation Plan to be developed as part of the Project. The implementation of an effective Weed and Pest Management Plan would also add towards this moderately significant, positive impact from the Project.

Significant Environment Benefits (SEBs), as outlined under the *Native Vegetation Act 1991*, are required for the Project in relation to cleared remnant vegetation. However, given the disturbed nature of the vegetation, together with its low habitat and biodiversity values, representativeness in the wider area, lack of rare and/or threatened species, lack of connectivity and its expected rapidity in regeneration, the SEB ratio required is 2:1 for vegetation along Swaffers Road and in the nitre bush Tall Open Shrubland and 5:1 in the Low Shrubland along the coastal cliff top, as determined following the methods outlined in (DWLBC, 2005). Nevertheless, consultation with the Native Vegetation Council may be necessary to finalise SEB ratios and other conditions. Further discussion of SEBs is provided in Section 7.3.7

6.9.2.4 Artificial Water Sources

The Project would harvest rainwater and surface flows for use in the processing of ore and everyday operation of the facility. Those artificial water sources may attract fauna to the Project that would not normally occur in the area (due to the lack of permanent surface water). These artificial water sources may also allow normally benign species present in the area to increase in population size because a normally limiting resource (that is, water) is now readily available all year round. Due to seasonal weather variability and actual Project water a permanent water body is unlikely.

Consequently, the potential impact of these water resources is considered to be of low significance. This determination is based on the following:

- The magnitude is low because there is the potential that species not normally occurring the Project area could become established, and thereby, potentially displace other species, however this is unlikely due to the expected variability in water presence. More than likely the effects would occur seasonally and not regularly.

6.9.2.5 Dust, Noise and Light

Potential impacts from dust, noise and light overflow from the operational phase of the Project are considered to be insignificant.

6.9.2.6 Barriers to Movement

Given the lack of highly mobile or terrestrial migratory species in the Project area, it is considered unlikely that the access roads, haul roads, fences, or other structures would act a significant barrier to any fauna movement. Therefore, impacts resulting from these are considered insignificant.

6.9.3 Decommissioning Phase

Impacts to the terrestrial ecology of the Project area expected during the decommissioning phase would largely be similar to those expected during the construction phase. Generally, it is expected that these would be not significant, and would mostly arise from rehabilitation of the Project area once the infrastructure has been removed.

6.10 Lipson Island

Construction and operation of the Project may potentially impact on Lipson Island Conservation Park, located approximately 1.5 km south of the jetty. Lipson Island supports populations of breeding birds, including the Little Penguin. A detailed survey and impact assessment was completed for Lipson Island in 2011, which is presented in Appendix J and summarised in Section 5.10.

6.10.1 Construction Phase

6.10.1.1 Noise Disturbance to Seabird Rookeries and Roosts

The Project would create noise during construction, operation and decommissioning. Some of this noise would potentially extend to Lipson Island, particularly pile drilling, driving and general construction. There would be ongoing noises during operational phases from mainly mechanical sources. Irregular, unusual or particularly loud noises or intense vibrations can cause disturbance to wildlife. Of particular conservation importance is the Little Penguin, which is sensitive to a range of disturbances. Disturbance from noise may result in lower breeding success and may inhibit individuals from returning from feeding at sea resulting in chicks not being fed and partners not being relieved. Noise, being stressful for couples, may also inhibit the initiation of breeding at the beginning of a breeding season, which may compromise Lipson Island seabird rookery. The rookery as elsewhere may be in decline irrespective of the Project. Breeding populations of penguins, cormorants and gulls, and most likely terns could be affected by noise.

The island is reasonably distant from the proposed development, which would afford some abatement from noise pollution. There is no documented evidence that noise emitted from such types of development at a distance of 1.5 km has affected bird rookeries of the species identified on Lipson Island. Birds are likely to habituate to low level constant noise. It is not expected that noise from the Project would affect migratory waders any more than the noise emitted by the breeding rookery. Seabird rookeries are noisy and frequent episodes above 70 dB were recorded. Noise modelling has predicted that the likely noise levels at Lipson Cove as a result of the Project's operational phase would be less than 33 dB(A) and therefore disturbance associated with Project noise is not expected (refer Section 6.6 and Appendix G).

6.10.1.2 Light Disturbance to Seabird Rookeries and Roosts

Penguins can be shy when landing and are known to be disturbed by lights. Illumination of Lipson Island foreshore during construction and operation may inhibit penguin landing, increase predation risk and decrease breeding success. Illumination may also allow increased predation of eggs and young by Silver Gulls.

Lipson Island would not be directly illuminated by the Project, since lighting would use domed focussed low level lights, the main source of which would be the jetty located approximately 1.5 km away. Some glow from the Project would likely be observable from Lipson Island as light reflects from surfaces and water, however this is not likely to cause disturbance.

Migratory waders and resident seabirds can be attracted to and collide with lighting and associated infrastructure. Such impacts are poorly quantified or recorded in literature. Although Lipson Island is 1.5 km from the jetty, migratory waders and resident seabirds readily travel such distances when returning to roost. Collisions with lights, particularly lighthouses are well documented, where they are the sole light source and located on migratory pathways. This is not the expected case at the Project and conditions for significant bird strike are not evident or likely.

6.10.1.3 Soil Erosion and Siltation of Adjacent Coastal Marine Environments

The Project's land construction phase could potentially mobilise sediment and debris to the marine environment. Soil erosion may have a detrimental effect on the flora and fauna of the intertidal zone of Lipson Island. The intertidal zone species are predominately benthic and sessile. Many larval forms also rely on suitable conditions for settlement and hence recruitment to the local site. Soil erosion would be controlled and the measures are detailed in Sections 6.2, 6.3 and 7.3.9. The sediment transport assessment presented in Section 6.13 demonstrates that suspended material in the marine environment is unlikely to reach Lipson Island and therefore negative impacts are not expected.

6.10.1.4 Weed Proliferation

Spread of weeds may increase due to areas being disturbed during construction onsite and increased traffic potentially transporting invasive seeds to the Project. Lipson Island contains large numbers of breeding and roosting seabirds. These large numbers limit vegetative growth, including weed growth by trampling, guano concentration and use as nesting material. Although weed seeds are likely to be transported to the Island, weed establishment would remain difficult. The project will not undertake any activity near Lipson Island and therefore weed impacts are unlikely.

6.10.1.5 Siltation and Turbidity Pollution of Lipson Island Marine Environment

Pier construction including pile driving may create some siltation and turbidity pollution of the immediate marine environment of the Project jetty. The amount of siltation and turbidity is dependent on the extent of the methods used, current movements and direction; it could cause an adverse impact of the marine ecological integrity of Lipson Island, particularly benthos communities.

During the pile driving process, pile fabric filtering would be used around each pile so that turbidity effects would be minimal. The sediment transport assessment demonstrates that suspended material in the marine environment is unlikely to reach Lipson Island (refer Section 6.13) and therefore negative impacts are not expected.

6.10.1.6 Dust Management

Dust is primarily an air-quality issue with potential impacts on human health; however, smothering terrestrial vegetation can affect regional ecology. If fugitive dust contains metals, other impacts on wildlife through exposure may occur. Dust emissions for the Project were modelled (refer Section 6.5) and demonstrate air impacts are not expected at Lipson Island. Lipson Island is reasonably distant and not expected to be affected by dust arising from the Project.

6.10.1.7 Impact of Feral Animals on Seashore Foraging Seabirds

Feral animals including foxes and cats have a range of impacts on native flora and fauna in Australia. Increased predator pressure from foxes and cats can have a negative effect on resident fauna species. This is particularly pertinent for foreshore foraging species such as migratory waders, Hooded Plover, terns and other species that return to breed or roost on Lipson Island. Fox predation is an identified risk to Hooded Plover, and without effective controls, the plover may become extinct in the immediate locality including Lipson Island.

Foxes and cats typically inhabit human environments and take advantage of microhabitats to sleep, for protection from the elements, breeding and hunting. Foxes and cats benefit from buildings which may be present during all phases of the Project and their numbers may increase through scavenging human food waste provisions which are also likely to be present. Due to the nature of the Port development, lack of onsite accommodation or waste disposal facilities thus us not expected to pose negative impact to Lipson Island.

6.10.1.8 Release of Invasive Marine Species from Ballast Water

Refer Section 6.11 for an assessment of the potential for invasive marine species.

6.10.1.9 Uncontrolled Spill of Wastewater Containing Oils, Solvents, Metals and Other Contaminants

A range of hydrocarbons and chemicals would be used on-site during the Project lifetime and spills may occur that may have impacts on marine flora and fauna of Lipson Island. The impact of a hydrocarbon or chemical spill on flora and fauna is dependent on many factors such as the nature of the chemical (i.e., solubility in water), volume, toxicity of the chemical spill to flora and fauna, the volume spilt and distance from Lipson Island. Surface water, groundwater and direct spills can impact on the marine environment. Lipson Island is afforded some protection being located approximately 1.5 km away from the jetty. Hydrocarbons and metal contaminants depend on tidal, current and weather conditions, which can plume to such distances. Of particular concern on Lipson Island are the roosting and breeding seabirds, such as Little Penguins, which are debilitated by oil spills (D'Amore & Jessop, 1995 and Harrigan, 1991) leading to toxicity. Hazards need to be released or reach Lipson Island to cause a detrimental effect. Wildlife, including Little Penguin and Australian Sea Lion, may be attracted to the Project where it may come into contact with such hazards.

Some pollutants have specific properties relating to environmental impacts such as bioaccumulation, biomagnification or particular toxicity to aquatic life forms. Information on such properties is generally readily available and often included in material data safety sheets. Management of hydrocarbons and chemicals is often well developed throughout industry and usually articulated in hydrocarbon and chemical spill management plans. Visiting vessels will not anchor in or around the immediate area of Lipson Island and fuel or hazardous material loading or unloading is not part of Port operations.

6.10.1.10 Wildlife Entanglement from Uncontrolled Release of Hard Waste

The presence of the Project (and increased human activity) would result in an increase in hard waste (for example ropes, and plastics) in the area. Hard waste can have a harmful and visible effect on local marine and seabird fauna. Plastic as it breaks down becomes more readily ingestible and releases harmful toxins that disrupt hormones. Once ingested, plastic cannot be digested or passed by an animal so stays in the gut (Harrigan, 1991) and it sates hunger, leading to starvation (Peter, 2010). Wildlife can be attracted to remains of food in cans. These can cut and trap animals that come in contact with them. Birds and fish can get tangled up or strangled by can collars and rope. In Little Penguins, fishing nets lines and six pack holders have caused broken limbs and nerve damage in the legs (D'Amore & Jessop, 1995). Such hazards need not reach Lipson Island to be detrimental to wildlife, as wildlife may be attracted to the Project where they can come into contact with the hazards.

Hard waste is currently collected from the Lipson Cove and adjoining beaches by volunteers on a monthly basis. The waste is categorised according to type, volume and source. The Project would contain all hard waste onsite and dispose of offsite therefore potential for these impacts is considered unlikely.

A Waste Management Plan would be implemented for the Project, which would prevent the uncontrolled release of waste. Hard waste would not be disposed of onsite or to the marine environment.

6.10.1.11 Disturbance to Lipson Island

Any planned improvement of the access roads, structures and commencement, operation and the ultimate decommissioning of a new industry has the potential to attract and introduce a significant increase of human traffic to the area. Increased awareness of Lipson Island Conservation Park and the adjacent beaches may result in increased human activity, using the area as a recreational destination (e.g., fishing, hiking, beach walking). Human presence brings a range of issues for management that includes direct and deliberate disturbance to seabird rookeries and roosts, noise, inappropriate behaviour, hard waste, weeds, disease and trampling. The presence of domestic dogs may increase with increased visitation due to interest in the Project.

The presence of humans on Lipson Island and the foreshore can be directly detrimental to breeding success of seabirds and Little Penguins. The nesting burrows on Lipson Island are built in a sandy substrate. They are fragile and at risk of collapsing under the weight of increased human traffic. Disturbance of adults and young has repeatedly been documented as detrimental to breeding success. Dogs would chase and disturb migratory wading birds on adjacent foreshores and attack and kill juvenile chicks that are unable to fly or flee. One of the most common terrestrial threats to Hooded Plover, migratory waders and Little Penguins are dogs, causing injury or death (D'Amore & Jessop, 1995). Even the presence of dogs on leashes can and would attract other dogs by their scent to the area.

The Project could be subject to increased public interest and visitation and therefore Lipson Island visitors may increase. The more common groups of intertidal fauna found in the current survey with a heavy dependent benthic living (i.e., relatively sessile) have a strong link to potential development impacts such as increased human visitation (i.e., trampling). Project related personnel are not expected to contribute to this, however general public visitors may. Lipson Island is a listed state park under Parks SA management, and outside the Project management area.

There may be an increase in recreational and angler boats to the Lipson Island locality. This presents further potential disturbances to the Lipson Island ecology, particularly as vessels enable easier direct access to the Island. The Project area would not be open to recreational fishing and therefore this is unlikely.

6.10.1.12 Increased Habitat for Terrestrial Invasive Species (for example, Silver Gull)

The presence of Silver Gulls is strongly tied to human activities and structures such as ports, which is relevant to the Project. Inappropriate and increased provision of food resources may increase local Silver Gull populations. If not managed, Silver Gull could increase in numbers at Lipson Island to the detriment of other seabird species by direct predation (particularly of eggs and juveniles) and competition for breeding sites. This is facilitated with disturbance to seabird rookeries from human presence and could be a rapid process. Waste management is discussed in Section 7.3.14.

6.11 Marine Ecology

6.11.1 Construction Phase

The proposed marine structures that would be constructed as part of the Project consist of a 25 m wide and 515 m long approach jetty, with a 55 m wide and 345 m berthing jetty which extends south from the approach jetty. Construction of the marine structures is expected to extend over an 18 month period.

The approach jetty would be constructed using end over end construction methodology. Construction would commence at the foreshore end of the approach jetty and proceed in a seaward direction. It is anticipated that approximately 64 piles (number subject to final design) would be installed along the length of the approach jetty structure. As the piling process progresses out to sea it would be followed by the installation of approach jetty deck structure and road structure. This would provide continual access from shore to the piling operation for transport of permanent materials, temporary materials and construction plant.

The construction of the berthing jetty and dolphins would involve the installation of approximately 120 piles (number subject to final design) using a jack up barge. A construction footprint was estimated of the potential impact zone and includes the area under the proposed jetty and berthing jetty, plus a buffer of approximately 5.5 m either side of the jetty (refer to Figure 2 in Appendix K). The use of the jack up barge for construction works would be restricted to use in this area.

The habitats in the vicinity of the Project area consist of intertidal rocky shores, intertidal sandy beaches, subtidal rocky reefs, subtidal seagrass meadows and subtidal sandy substrate. It is considered likely that construction-related effects below the high water mark would be transient in nature, generally lasting only as long as the construction activities are underway. These effects are considered likely to be predominantly localised to the area within the immediate vicinity of the jetty, however some effects (such as acoustic pollution from pile driving activities) may be apparent further afield. A more detailed consideration of the potential for impacts to occur has been provided below.

6.11.1.1 Native Vegetation Clearance

Within the Project area, macroalgal dominated rocky reefs and seagrass meadows provide the largest cover of native vegetation. Macroalgal assemblages are also present on the intertidal rocky shores; however the cover is largely restricted to a limited area low on the shore. These habitats are also present more broadly in the region, and the communities recorded within the Project area are considered representative of those found further afield. Ecological surveys undertaken for the Project have provided information about the extent and condition of these habitats. This information is summarised in Section 5.9 and in more detail in Appendix I.

The extent of vegetation loss within the Project area is anticipated to be restricted to the construction footprint (refer to Figure 2, Appendix K). Loss of vegetation would occur directly under each pile; however the extent of this loss is anticipated to be relatively minor when considering the extent of these habitats in the area. For the rocky reef and seagrass habitats, an estimate of the area which would experience at least some level of disturbance has been calculated. This estimate represents the construction footprint and includes the area under, and immediately surrounding the jetty (up to 5.5 m either side). While it is expected that some loss of cover would occur during the construction of the jetty, it is considered likely that the use of mitigation measures would play a key role in reducing the potential for increased turbidity, and as such, a significant proportion of the macroalgal and seagrass assemblages would likely survive the construction phase of works. Drilling activities undertaken on the intertidal rocky shore have the potential to generate material that could impact water quality (i.e. turbidity or contaminants). Mitigation measures to manage such material will be implemented as part of the CEMMP. Without these measures being effectively implemented, there is the potential for reduced light and sediment deposition to impact macroalgal assemblages and seagrass meadows.

The area that has been calculated as being potentially subject to disturbance during the construction phase is approximately 1,930 m² for the rocky reef habitat and approximately 4,702 m² for the seagrass meadows. These estimates are considered conservative as it is unlikely the entire area would be impacted by construction activities.

The area identified as seagrass habitat, can be loosely divided into different seagrass associations. Coarse estimates for the area of potential construction impact are as follows:

- Mixed meadows of *A. antarctica*, *P. sinuosa* and *P. angustifolia* constitute approximately 1,317 m² in the shallower areas of the seagrass habitat at the Port (at approximately 7-9.5 m BSL). This area contains moderate cover of approximately 50% seagrass and 50% sandy substrate.
- Mixed meadows of *P. sinuosa* and *P. angustifolia* constitute approximately 3,385 m² in the deeper areas of the seagrass habitat at the Port (at approximately 10 to 12 m BSL). In this area, *Posidonia* spp. is dense and constitutes approximately 90% cover, with the remaining areas being bare sand.

In addition to these areas, very sparse cover of *H. nigricaulis* and *H. australis* is present in the deeper areas of the site beyond 12 to 14 m depth (to a depth of approximately to 16 m BSL). The area where these seagrasses may be impacted during construction is estimated to be approximately 6,520 m². However, within this area *H. nigricaulis* and *H. australis* cover is sparse (i.e., only approximately 5 to 10% of the total estimated area). Some localised disturbance may occur should the jack-up barge be used within this depth band. However, as this species possesses an opportunistic life-history strategy (Edgar, 2001) and is considered a coloniser species, it is expected that recovery would occur after construction activities cease. All of these areas would be subject to shading subsequent to the completion of the jetty.

The extent of potential disturbance or clearance to the intertidal rocky shore has been estimated at approximately 430 m² (refer Appendix K). However, as only a very small component of this area (the area fringing the subtidal zone) supports algal assemblages (with the remaining areas being dominated by sparse patchy cover of organisms on otherwise bare rock), this figure is considered to be an overestimate of the area potentially affected by the Project.

Seagrasses are protected under the South Australian *Native Vegetation Act 1991*. The *Native Vegetation Act 1991* provides for the preservation and enhancement of native vegetation and for the regulation of the clearance of native vegetation. For the purpose of the Act, native vegetation means a plant or plants of a species indigenous to South Australia including a plant or plants growing in or under waters of the sea. Seagrasses are plants and are protected under this Act. Marine algae are not classified as plants, and therefore are not protected under this Act. Clearance (possibly including incidental displacement) of seagrasses is subject to a clearance application under the Act. As reported in the Native Vegetation Council's (NVC) guide to the Regulations under the *Native Vegetation Act 1991*, an exemption [5(1)(c)] deals with clearance of native vegetation for developments which have been declared by the Minister as Major Developments, subject to all parts of the regulation being met. The NVC would not restrict reasonable clearance for infrastructure; however, the location of the works must minimise the impact on areas of native vegetation.

There is the potential for additional impacts to occur in macroalgal and seagrass communities as a result of increased turbidity from pile driving and drilling activities. Seagrasses and algae are susceptible to decreases in water clarity and sedimentation and therefore operational measures (such as silt curtains) would be employed to minimise impacts from this source. If sediment is generated from drilling activities, this sediment would be extracted and pumped to the seabed within a disposal area. This disposal area would be bunded by silt curtains and should be established within the footprint of the jetty and away from the rocky reef and seagrass habitats. The optimal placement of the disposal area would be in water deeper than 17 m BSL as this area is predominantly characterised by bare sandy substrate.

6.11.1.2 Revegetation, Habitat Enhancement and Compensation

Environmental offsets provide compensation for those impacts which cannot be adequately reduced through avoidance and mitigation. In assessing the merits of avoidance, mitigation, and offsets it has been noted that the degree of adverse impact on the seagrass and macroalgal habitats at the Project can be considered minor to moderate, with a relatively limited areas being disturbed or removed by the construction and operation phases.

As much of this coastline currently has naturally occurring seagrass and macroalgal habitats, any restoration effort may have to be located elsewhere. This may not be environmentally beneficial as it could involve creating seagrass habitat in an area where the species may not naturally occur (which further reduces the chance of restoration success), which in itself could be considered an impact on the existing marine environment.

Consideration of the potential for impacts of seagrass and macroalgal communities indicates that the scale and intensity of the impacts of the development may be relatively insignificant in terms of the wider Spencer Gulf ecosystems, and that the potential benefits to be gained through implementing restoration programmes of a comparable scale would likely be minimal. In this case, it is suggested there is not sufficient magnitude to employ large-scale compensatory measures and the focus should be on mitigation and environmental management practices to minimise the overall loss of habitat at the Project.

The environmental offset for seagrass and macroalgal habitat clearance due to the construction of the jetty would be created by a terrestrial SEB, as this is considered to be the most effective mechanism to compensate for the marine environmental impacts at the Project.

6.11.1.3 Rare and/or Threatened Species and Communities

During the subtidal reef surveys, a male/female pair of the Crested Threefin fish (which is endemic to South Australia) was recorded. Although Edgar (2008) described this species as rare, Baker (2009) noted that it has been commonly recorded, and appears not to be rare within its known range.

The leucosiid crab, *Cryptocnemus vincentianus* has been identified as occurring in the Project area. One specimen was found in the seagrass habitat within the vicinity of the proposed jetty. The identity of the specimen was confirmed by taxonomic experts at the Museum of Victoria. The occurrence of this specimen is notable as it is the only species in the family *Cryptocnemus* (of the five which occur in Australian waters) which is known to occur in southern Australia waters, and its documented presence in Australia is based on a single specimen found in 1927 (Poore, 2004). This specimen was recorded from dredged material off Semaphore (Davie, 2002) in Gulf St. Vincent. In addition to the Gulf St. Vincent specimen, this species has been reported from subtidal rocky reef samples collected in Western Australia (Keesing, 2006).

This crab is considered to be a naturally rare species, and, as virtually nothing is known about this species (including its distribution, habitat requirements or biology) it is difficult to ascertain what the potential for impacts may be. The three reported specimens of *C. vincentianus* have been found in two (potentially three) different habitats (seagrass and subtidal reef, while the sample from the dredged material may have been from seagrass or sediment). Given the diversity of the habitats, it is unclear whether this species utilises seagrass and reef habitats at different stages of its life cycle or whether it opportunistically exploits different habitats dependent on local environmental conditions. In the absence of more detailed information about the species, some inference can be made about the potential for impacts based on what is known about other species of decapod crustaceans.

For species of crabs, the life cycle follows a typical pattern whereby the adult female crab lays eggs, and the emergent larvae enter the water column as zooplankton. Once developed, they settle out of the water column onto the sea floor as juvenile crabs. Bottom-dwelling species such as crabs utilise the larval stage of their life cycle as a means of facilitating dispersion of the species (Ritz et al., 2003). Given that the distribution of the species in the region would be largely determined by larval dispersion, it is considered unlikely that there would be a detrimental impact to the species as a result of the predicted localised loss of habitat under the proposed jetty.

6.11.1.4 Direct Mortality of Individuals

Direct mortality of individuals of species may occur directly beneath where piles are installed. This is particularly true for sessile or slow moving species which would be unable to vacate the area during pile installation. The number of individuals which are likely to be affected is considered likely to be low, and as these populations are typically naturally highly spatially and temporally variable, these organisms are likely to re-establish during subsequent settlement events. Therefore the potential for impacts at the population level is considered to be negligible.

There is also the potential for sediment deposition from drilling activities to impact reef biota as a result of smothering. These impacts can include interference with the filter-feeding of sessile invertebrates (Turner et al., 2006), with the feeding apparatus becoming clogged (Irving and Connell, 2002). Pile driving activities would also generate high levels of underwater noise and this has the potential to result in mortality or injury to some fish up to 500 m from the source. Site-associated reef fish species are likely to be the most susceptible to pile driving activities. Notwithstanding this, no effects at the population level are anticipated as the area which may be affected is small and the duration of the disturbance would be limited to the construction phase.

An assessment of the potential impacts from acoustic pollution has been undertaken, the details of which are summarised in Section 6.11.1, and provided in full in Appendix G.

6.11.1.5 Habitat Fragmentation

The extent of vegetation loss during construction is anticipated to be restricted to the area within the footprint of the jetty, and predominantly associated with pile installation, refer Sections 6.11.1 and 6.11.1.1. It is considered likely that habitat loss would be patchy and that most habitats would largely remain intact. Additional loss of vegetation may occur as a result of shading or sedimentation subsequent to the construction of the jetty.

6.11.1.6 Pest Species

The Asian mussel, *Musculista senhousia*, has been found in the Project area. *M. senhousia* is a member of the Mytilidae family and is native to the Pacific Ocean. It is an invasive species in California, the Mediterranean, Australia, and New Zealand (NIMPIS, 2009). Common names for this species include the Asian date mussel, the Japanese mussel, Senhouse's mussel, the green mussel and the green bag mussel.

The majority of individuals were found in samples collected in seagrass beds in the vicinity of the proposed jetty. There were no individuals recorded in the sandy sediment samples collected further offshore. Marine processes would be developed and implemented to reduce the possibility of transferring this species to other locations via vessels leaving the Project.

During construction there is the potential for additional pest incursions to occur. Possible means for the introduction of non-indigenous marine species at the Project include organisms present in ballast water or as hull biofouling being translocated via construction equipment (i.e., dredges and barges) during the construction phase and with shipping traffic during the operational phase. The creation of jetty structures provides opportunity at the Project of potential translocation for colonisation by marine pests onto the newly-formed artificial substrates or in disturbed marine habitats.

Additional discussion regarding marine pest species and management of risks associated with marine pests can be found in Section 7.

6.11.1.7 Noise

Increases in underwater noise are expected to occur at the Project as a result of the construction phase. These increases are considered to have the potential to result in physical and/or behavioural effects on sensitive receptors such as marine fish and marine mammals. The two main sources of project-generated noise from construction activities are pile driving (impact and vibration) and pile drilling. Sound sources can be categorised generally as pulsed (pile driving) or continuous (drilling). Offshore seismic surveys and underwater blasting are not expected to be required for the construction of the jetty. As such, these activities were not considered as part of this assessment.

Underwater noise modelling has been undertaken for the main project activities that have the potential to result in effects on sensitive receptors. A descriptive analysis of each Project noise source, as well as Project-specific noise modelling, is provided in Appendix G. Based on the outcome of the underwater noise modelling, the predicted noise effects were compared to values known to cause behavioural disturbance or injury to marine mammals and marine fish. The assessment is based on those species previously identified (refer to Section 5.10 and 5.11) as being potentially present in the vicinity of the Project area, together with a review of the available literature. The potential impacts on sensitive receptors from increased noise are discussed qualitatively below.

Fish

Sensitivity to sound differs among fish species based on their anatomical form. There is considerable anatomical and physiological variation amongst fish with respect to hearing structures, suggesting that various species may detect and process sound in different ways (Popper and Fay, 1993). Physical variability in a fish species' hearing anatomy generally determines its overall hearing sensitivity (Popper et al. 2003; Yan et al. 2000). Fish can be divided into two broad categories: hearing generalists ("non-specialists") and hearing specialists.

The extent of potential noise impacts on fish is not comprehensively understood. It is known however, that intense impulsive signals such as those produced from pile drivers, can cause fish kills, and signals of a smaller magnitude can cause behavioural changes. Fish hearing may be temporarily or permanently damaged by high-intensity sounds. However, the extent of damage would depend on the auditory threshold of the receiving species and this would vary from species to species (McCauley and Kent, 2008).

Pile-driving noise during construction is of potential concern for marine fish due to the high sound pressure levels transmitted through the water column. These compressive shock waves (overpressure) are characterised by a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure (Wright and Hopky, 1998). These shock waves can result in physical damage and sometimes direct mortality to nearby fish (Caltrans, 2001). In finfish, the swim bladder is the primary site of damage although the kidney, liver and spleen may also be ruptured. Studies have shown that fish eggs and larvae also may be killed or damaged from overpressure (Popper and Hastings, 2009). There is evidence that smaller fish appear to be more vulnerable to overpressure impacts than larger fish and fish near the surface are more vulnerable than deep fish (Keevin and Hempen, 1997).

Based on the literature and noise modelling predictions, impact pile driving has the potential to result in physical injury to marine fish within close range of the source. The predicted sound pressure level (SPL) for impact pile driving based on a single pile strike is 190 dB re 1 uPa root mean square (RMS at 20 m). Based on multiple pile strikes (as is expected for this activity), the cumulative sound exposure level (SEL) is predicted to exceed the injury threshold for fish (187 dB re 1 uPa) in the immediate area of impact pile driving works (up to 470 m from the source). Underwater noise generated from either vibration pile driving, drilling, and vessel traffic is not anticipated to exceed the injury threshold for fish during any phase of the Project. Predicted underwater noise from impact pile driving, vibration pile driving, and drilling may exceed the potential behavioural threshold of fish (150 dB re 1 uPa) for distances from the source up to 4,650 m, 215 m, and 5 m, respectively.

Based on a review of the literature and noise impact modelling (refer Appendix C of Appendix G), it is expected that underwater noise generated by construction activities would not exceed levels known to cause irreversible damage or death to fish (adults and eggs), with the exception of during impact pile driving activities when cumulative SEL could exceed the threshold for injury to fish at distances < 470 m from the source. Within this zone of potential injury, impact pile driving could cause physical impacts to fish species with moderate to high noise sensitivity.

No effects at the population level are anticipated. Concerning possible effects on fish eggs and larvae, it is considered likely that effects would be limited to the immediate vicinity of the source (<5 m). Given the relatively small volume of water affected, no measurable effects are expected and no effects at the population level are anticipated. In addition, construction of the jetty would begin onshore and would advance seaward, allowing for an extended period of response time by acoustically sensitive fish in the area (by means of avoidance or habituation).

Marine Mammals

Marine mammals are acoustically diverse, with wide variations in ear anatomy, frequency range and amplitude sensitivity. The general trend is that larger species tend to have lower frequency ranges than smaller species (Baker, 2004). The efficiency of underwater sound propagation allows marine mammals to use underwater sounds as a primary method of communication with one another. Toothed whales use echolocation sounds to detect the presence and location of objects, other whales of the same species, and prey (Richardson et al., 1995).

There is considerable variation among marine mammals in both hearing range and sensitivity. Toothed whales (such as dolphins) commonly have good hearing between 200 and 100,000 Hz; whereas several baleen whales (i.e., humpback whales), fur seals and sea lions have good hearing in the lower frequency range. The upper functional range for most baleen whales has been predicted to extend to 20 or 30 kHz (Richardson et al., 1995).

Little knowledge exists on the habituation of marine mammals to anthropogenic noises. Direct lethal effects attributable to acoustic emissions are not represented in available literature, although military sonar trials have been implicated in mass stranding events. Richardson et al. (1995) postulated that *“it is doubtful that many marine mammals would remain for long in areas where received levels of continuous underwater noise are >140 dB at frequencies to which the animals are most sensitive.”*

Impulsive pile driving (hammering) is considerably louder than vibrational pile driving or underwater drilling, with levels as high as 131 to 135 dB re 1 uPa measured 1 km from a hammer used for pipe installation (Richardson et al., 1995). Blackwell et al. (2003) measured sounds generated by impact driving conductor and insulator pipes for oil and gas wells. Individual pile-driving pulses generated a mean underwater broadband level of 151 dB re 1 uPa. These pipes were similar in size and material to the proposed piles for the Project.

The threshold peak impulse sound pressure for direct physical trauma in marine mammals is generally considered to be > 200 dB (Gordon et al., 2003). This being the case, marine mammals would not be expected to experience permanent hearing impairment from sound pressures generated by pile driving activity, even when very close to the source. Effects on behaviour are considered more likely to occur. In addition to masking of communication and echolocation signals, pile driver noise could interfere with environmental sounds that animals listen to, for example the sound of surf or prey species. In addition, underwater noise could startle or displace animals. Wursig et al. (2000) recorded the impact of pile driving into the seabed, in 6 m to 8 m depths of water, on humpbacked dolphin behaviour. No overt behavioural changes were observed in response to the pile-driving activities; however, the animals' speed of travel increased and some dolphins remained within the vicinity while others temporarily abandoned the area. Dolphin numbers returned close to normal once pile driving had ceased.

Based on noise modelling predictions, impact pile driving could result in physical injury to marine mammals within close range of the source. The predicted SPL for impact pile driving is 190 dB re 1 uPa (RMS at 20 m) based on a single pile strike. This SPL is predicted to exceed the injury threshold for pinnipeds (190 dB re 1 uPa) and cetaceans (180 dB re 1 uPa) at distances of up to 93 m and 431 m from the source, respectively. Underwater noise from vibration pile driving, drilling, and vessel traffic is not anticipated to exceed the injury threshold for pinnipeds or cetaceans during any phase of the Project. Predicted underwater noise from impact pile driving and vibration pile driving may exceed the behavioural threshold for marine mammals (160 dB re 1 uPa – impulsive) for distances from the source up to approximately 30 m and 50 m, respectively. Predicted underwater noise from underwater drilling may exceed the behavioural threshold for marine mammals (140 dB re 1 uPa – continuous) for distances from the source up to 25 m.

Many of the marine mammal species identified as potentially occurring in the Spencer Gulf region (refer Sections 5.10 and 5.11) are protected under Australian legislation. Southern Right whales are protected under State and Federal legislation and are known to be transient in this region during their calving season (between May and November). During this period, Southern Right whales would be more susceptible to impacts from pile driving activities. Effects could range from changes to their distribution, migration, or behavioural patterns.

In summary, it is considered unlikely that underwater noise generated by construction and operational activities would exceed levels known to cause injury to marine mammals, with the exception of during impact pile driving activities when cumulative SEL could exceed the threshold for injury to marine mammals at very close distances from the source. The Project area is not a known significant breeding or habitat area for marine mammals.

6.11.2 Operational Phase

Once operational, it is anticipated that the Port Spencer facility would accommodate Panamax and Cape class vessels. Initially, approximately 20 vessels carrying hematite and grain would berth per year. This is an approximate frequency of one vessel every 18 days. When magnetite ore is processed at the mine, a predicted 50 Cape class vessels would increase the frequency of berths to seven vessels each month (Golder, 2011c). Enclosed conveyors would be used to transport ore and grain to the jetty and along it to the ship loader.

The potential impacts from the operational phase of the Project may include effects from the following:

- Presence of infrastructure (such as loss of habitat from shading or increased sedimentation from altered hydrodynamic conditions)
- Reduced water quality associated with the export of materials and shipping activities
- Introduction of marine pest species, or
- Shipping activities (for example, noise, offshore anchoring or accidental release of hydrocarbons).

Consideration of the potential for impacts to occur from these (and other sources) is provided below.

6.11.2.1 Habitat Fragmentation

Subsequent to the jetty being completed, it is anticipated that there would be loss of vegetation as a result of decreased light availability due to shading by the jetty structure, and potentially from increased sedimentation due to changes in the local hydrodynamics surrounding the jetty.

If habitat fragmentation occurs (through complete loss or reduced seagrass cover), these changes may bring about localised changes in some faunal assemblages associated with the seagrasses. Edgar (2001) reports that relatively slight changes in the composition or density of seagrass can produce a disproportionately large change in the faunal assemblages. Tanner (2005) showed fragmentation of seagrass meadows in the Gulf of St Vincent to have a negative effect upon populations of mobile crustaceans (e.g. ghostshrimp, amphipods). Sessile or sedentary infaunal species (e.g., polychaete worms, bivalves) were little affected. Where seagrass loss occurs, it is predicted that the species composition of macro-infauna assemblages would change to reflect assemblages that are more typically found in sandy substrates in the area.

The effects of habitat fragmentation, should they occur, are expected to be predominantly limited to the area beneath the jetty, with the potential for some additional localised losses either side of the jetty (up to approximately 500 m). Therefore, the displacement of marine fauna as a result of the installation of the jetty is considered to occur at a relatively small scale compared to the extent of seagrass meadows and macroalgal assemblages present in the region.

6.11.2.2 Shading

Changes which may occur are considered likely to be from the loss of species which are dependent on high light levels. Changes in the faunal assemblages may also occur if they are dependent on specific algal species.

The orientation of the proposed jetty would have an influence on any shading effect and the approximately east-west orientation of the main section of the proposed jetty approaches the maximum shading effect possible due to the east-west movement of the sun. During summer when the sun is at its highest orientation, the shading effect would be greatest as the area directly beneath the proposed jetty would receive reduced light almost all day.

Nonetheless, it is unknown if this level of shading would be detrimental to the long-term survival of macroalgae and seagrasses and due to variation in the angle of the sun across seasons, the areas under or to the south of the jetty that receive maximum shading would vary across the year; this phenomenon may well assist with persistence of vegetation under the jetty. However, if turbidity and sedimentation are also increased due to shipping activity adjacent to the jetty, then the synergistic effects of reduced light from both the presence of vessels and the jetty structure may be significant.

The impacts of shading from the proposed jetty would likely depend on the tolerance of macroalgal and seagrass species to reduced light, and the amount of light that is able to penetrate beneath the jetty. The depth ranges of plants reflect the different light-trapping abilities of different species. Therefore, as the depth to which macroalgal and seagrass species can occur may be a useful indicator of the light tolerance of that species. However, the survival of species under the jetty may be a result of more complex interactions which could also include changes in water clarity (Edgar, 2001).

For the rocky reef and seagrass habitats, an estimate of the area which is anticipated to experience at least some loss of vegetation has been calculated. This estimate represents the area under, and immediately surrounding the jetty (up to approximately 5.5 m either side). The area which has been calculated as being subject to at least some level of disturbance is 1,930 m² for the rocky reef habitat and 4,702 m² for the seagrass meadows. It is recognised those areas potentially disturbed during operations are similar to those expected to be impacted during construction. Within the seagrass meadows different seagrass associations occur. The following estimates loosely define the area of each seagrass association which may be impacted by ongoing shading from the proposed jetty.

- Mixed meadows of *A. antarctica*, *P. sinuosa* and *P. angustifolia* constitute approximately 1,317 m² in the shallower areas of the seagrass habitat at the Port (at approximately 7-9.5 m BSL). This area contains moderate seagrass cover, of approximately 50% seagrass and 50% sandy substrate.
- Mixed meadows of *P. sinuosa* and *P. angustifolia* constitute approximately 3,385 m² in the deeper areas of the seagrass habitat at the Port (at approximately 10 to 14 m BSL). In this area, *Posidonia* spp. is dense and constitutes approximately 90% cover and 10% bare sand.

- In addition to these estimates, an area of approximately 6,520 m² constitutes very sparse cover of *H. nigricaulis* and *H. australis* (between approximately 14 to 16 m depth). Within this area these seagrasses are thought to cover only approximately 5 to 10% of the total estimated area.

The likely extent of species loss is discussed in more detail below.

Macroalgae

The major canopy-forming species at the Project have been recorded to occur at a range of depths. The kelp *Ecklonia radiata* can tolerate low-light conditions and is found at depths to 44 m, and *Scaberia agardhii* and *Cystophora monilifera* and *Cystophora moniliformis* extend to a similar depth. Species from the Sargassum and Arthrophyucus subgenera have maximum depths varying from relatively shallow (5 m to 12 m) to relatively deep (approximately 40 m) (Edgar, 2008; Womersley, 1987). *Cystophora expansa* and *Sargassum decipiens* have maximum depths of approximately 12 m. Species that may be near their tolerance of light based on their maximum depth are *Cystophora brownii* (4 m), *Cystophora subfarcinata* (7 m) and *Caulocystis cephalornithos* (7 m). In the former two cases, however, this may relate to their preference for relatively exposed conditions, as wave exposure, like light, is attenuated with depth. It is possible that there may be shifts in macroalgal community structure below the proposed jetty but it is considered likely that no overall loss of canopy structure and function would occur as a result of shading.

Changes to macroalgal assemblages from shading (if they occur) are considered likely over a relatively small spatial scale for the life of the Port. However, based on the current understanding of the extent of the potential impacts, it is expected that recovery of macroalgal communities would occur once the Port ceases to operate and the infrastructure is removed.

Seagrasses

The effects of shading on seagrasses are thought likely to be limited to area in the immediate vicinity of the jetty. The most abundant seagrass species at the Site are *Posidonia angustifolia*, *Posidonia sinuosa* and *Amphibolis antarctica*. The most recent field investigations indicated that *P. angustifolia* is the more dominant of the two *Posidonia* species present at the Site. Sparse, patchy coverage of *Heterozostera nigricaulis* and *Halophila australis* also occurs. These species of seagrass are all endemic to Australia.

P. angustifolia is a widespread species which can live in deeper waters and disturbed environments with low light. The depth range for *P. angustifolia* is from 2-50 m in open near-shore waters. At shallower depths and in relatively sheltered situations, this species occurs sympatrically with *P. sinuosa* and *Amphibolis* spp.. At depths of 35 m it has been observed with sparse *Heterozostera tasmanica* and *Halophila ovalis* (IUCN 2011a). As *P. angustifolia* is adapted to low light conditions, it may prove to be reasonably resilient to the effects of shading from the jetty.

Around Australia, there have been major areas of loss across the range of *P. sinuosa* which have caused significant population declines. Major threats to this species are a decrease in water quality, sedimentation and coastal development (IUCN, 2011b). This species is listed as Vulnerable under criterion A2 on the IUCN Red List for Threatened Species. However, while *P. sinuosa* is listed as Native Vegetation under the *SA Native Vegetation Act 1991* (as are all of the seagrasses present at the Site), it is not listed as endangered, vulnerable or rare under the *National Parks and Wildlife Act 1972* or the *Commonwealth Environment Protection and Biodiversity Act 1999*. This species is considered likely to be more susceptible to the effects of shading from the jetty than *P. angustifolia*, and where losses occur, it is not anticipated that recovery would occur.

A. antarctica is a seagrass that dominates (with *Posidonia* spp.) the subtidal environment in western and southern Australia. Overall, its population is thought to be stable (IUCN, 2011c). In south-eastern Australia, it forms patches of varying sizes at the mouth of some bays, and occurs in areas dominated by sandy siliceous sediments and exposed to ocean swells. It can be present to depths of 22 m in clear non-polluted water. This species is considered likely to be more susceptible to the effects of shading from the jetty than *P. angustifolia*.

Shading experiments on these genera have shown that they are remarkably tolerant of shading for prolonged periods (e.g. Mackey et al., 2007, Collier et al., 2009, Lavery et al., 2009). Nonetheless, if the level of shading is sufficiently high and for prolonged periods, then death of these seagrasses can occur. The impacts of shading from the proposed jetty would depend upon the amount of light that still penetrates beneath the proposed jetty and how this varies across the depth gradient of seagrass distribution. If shading is heavy enough, then it is considered likely that the deeper *Posidonia* beds, which are already near their lower light limits, would die before the shallower *Posidonia*.

The effects of shading from the jetty are considered likely to result in at least some changes to the composition and abundance of the seagrass meadows. While the immediate effects of shading are anticipated to be restricted to the area under the jetty, if seagrass loss does occur, localised changes to sediment stability and changes to the faunal assemblages associated with these areas may subsequently occur.

6.11.2.3 Sedimentation

The installation of any structure in the marine environment has the potential to impact on local coastal hydrology, including changes to currents, tidal flow, and sediment deposition in the nearshore zone. Hydrodynamic modelling has been undertaken as part of the assessment of effects from the construction of the jetty and is presented in Appendix L. This assessment indicated the following:

- Sedimentation on the intertidal rocky shores and subtidal rocky reef areas as a result of altered hydrodynamic conditions is not expected to occur, although the potential for increased sediment movement (rather than accretion) through this area has been identified., and
- Some sedimentation may occur inshore of the berthing jetty, with increases to seabed levels predicted to be in the order of 0.03 to 0.05 m per year.

The extent of impacts from sedimentation (if they occur) is likely to reflect:

- The extent of changes to substrate characteristics

- The extent of seagrass loss
- The actual (versus predicted) rate of accretion, and
- The ability of local species to recolonise newly accreted substrates.

Discussion regarding the potential impacts on marine communities from increased sedimentation is provided below.

Macroalgae

Impacts to subtidal rocky reefs would likely be limited to the headland where the jetty would be constructed. The reefs to the north and south of the Project area are considered likely to be outside of the zone of potential impacts. Notwithstanding this, a conservative upper extent of approximately 52,463 m² has been calculated for the area which may be affected by increased sediment movement (and therefore potentially from increased sediment deposition). Current modelling predictions indicate this is not expected to occur.

The effect of increased sediment movement could result in interference with the filter-feeding of sessile invertebrates, with the feeding apparatus becoming clogged (Irving and Connell, 2002). On subtidal reefs, Turner and Cheshire (2002) found a significant reduction in recruitment and slow recovery for a number of canopy-forming taxa (the same or similar species to those at the proposed site) in areas impacted by a sediment plume. A reduction in larger canopy-forming taxa can be followed by, or exacerbate a shift to, organisms with sediment-trapping morphologies (typically turfing species) or opportunistic species (Airoldi 2003; Turner et al. 2006).

Based on the sediment transport modelling undertaken for this Project, impacts from sedimentation are expected to be minimal on rocky reef areas. Recovery of macroalgal communities would therefore be considered likely within a relatively short timeframe after Port operations cease (and infrastructure is removed).

Seagrasses

Given the region is a moderately high energy coastline, and owing to the ability of seagrass to trap suspended sediments it is possible that the existing habitats would absorb this level of additional sediment input/movement as a natural process. Notwithstanding this, as seagrasses are susceptible to decreases in water clarity and sedimentation (Edgar, 2001), ongoing monitoring to assess project-related changes to seagrass meadows should form an important component of future ecological surveys. As with the effects of shading, it is considered likely that sedimentation effects (if they occur) would be observed in deeper *Posidonia* meadows (which appear to be already nearing their light limits), before those in shallower areas.

To reflect the potential for impacts to occur more broadly than the jetty footprint, a more conservative upper extent of approximately 113,406 m² has been calculated due to the possibility of impacts occurring from increased sediment deposition and decreased water quality. This is considered an over estimate as it is considered unlikely that extensive loss of seagrasses would occur at this scale.

As with the rocky reef biota, filter-feeding sessile invertebrates in seagrass meadows may also be impacted in this area by increased sediment movement resulting in interference with feeding apparatus.

In addition to general inshore increases in sedimentation from altered hydrodynamic conditions, the extent of blow-outs or sand patches within the seagrass meadows may also increase. These changes may result from loss of seagrass cover and subsequent sediment instability. Furthermore, scour holes around the individual jetty piles are predicted to form. These scour holes are likely to be approximately 0.3 to 1.4 m in depth with a long-shore length of 0.6 to 2.0 m (ASR, 2011). These areas however, may be affected by these additional changes would likely be the same as those affected by shading (for scour holes) and sedimentation (for increased sandy patches).

Seagrass recovery subsequent to the closure of the Port would depend on the extent and nature of the seagrass loss over time, as well as the extent and nature of any (future) pressures which are unrelated to the operation of the Port. Given the current understanding of the potential for operation impacts, and assuming the environmental conditions in Spencer Gulf remain relatively consistent over time, it is expected that seagrass communities would recover once the Port ceases to operate (and the infrastructure is removed from the marine environment). This is due to the nature of the losses which, if they occur, are expected to be:

- Localised (for example, primarily under the proposed jetty, however if they occur more broadly, are likely to be restricted to up to 500 m either side of the proposed jetty), and
- Not complete loss of vegetation (for example, an overall reduction in vegetative cover or increased habitat fragmentation/patchiness).

The nature and extent of these losses suggests that localised sources of seagrass, which would aid in future recruitment would remain and these would support the recovery of seagrasses in this area.

Macro-infauna

An increase in the concentration of suspended particulates has the potential to impact on filter-feeding organisms, especially polychaete worms, molluscs, ascidians (sea squirts) and sponges (Carballo & Naranjo, 2002). These organisms rely on the intake of particulate matter from the water column as a means of nutrition. Some species can be particularly sensitive to increases in suspended sediment loads as their feeding apparatus becomes bombarded with particles that interfere with their feeding and respiratory currents. This may lead to a reduction in total ingestion and a reduced scope for growth. Other effects include changes in respiration rates, abrasion, impacts on larval growth and development as well as egg development.

Resuspension of seafloor sediments can lead to changes in light penetration through the water column as well as deposition of these sediments which may smother benthic organisms. Maurer et al. (1980, 1981, 1982, 1986) examined the ability of a wide range of invertebrates to migrate to survive burial and data indicates that the process of recovery can commence immediately after or even during the disturbance. Available data indicates adults and juveniles of invertebrate species similar to those inhabiting the substrates of the Project area appear to be largely tolerant of exposure to suspended solids for extended periods of time (Palermo et al., 1990) and are readily able to migrate back to the surface following burial (Roberts, 1990). This is most likely the result of the adaptation of those organisms to naturally higher concentrations and higher variability of suspended solids concentrations encountered in areas of high primary productivity (i.e. seagrass beds) compared to the open ocean and coastal waters. Palermo et al. (1990) concluded that the sediment released during marine construction activities (dredging in this case) is not generally expected to have a major or long-term detrimental effect on benthic communities. Similar

conclusions were reached by Peddicord et al. (1975), McCauley et al (1977), Peddicord & McFarland (1978) and Wilbera et al (2008).

6.11.2.4 Pest Species

Non-indigenous marine species are marine animals or plants that are not native to Australia but have arrived in the country via pathways such as shipping and other marine-based activities. The establishment and spread of these species can result in pest populations that have the potential to significantly impact marine ecosystems, environments and industries. Australia has over 250 non-indigenous marine species, some of which are aggressive pests. The non-indigenous marine species found in parts of South Australia currently include toxic dinoflagellates, ascidians, bryozoans, hydroids, crustaceans, molluscs, polychaete worms and aquatic weeds (NIMPIS, 2009).

Possible means for the introduction of non-indigenous marine species during the operation of the Project includes organisms present in ballast water or as hull biofouling being translocated with shipping traffic. The release of marine pests with ballast water discharges is most likely if ballast water was taken up in areas known to contain such species (e.g., Hobart & Port Phillip Bay) or if mid-ocean exchanges had not been successfully completed.

The creation of jetty structures provides opportunity at the Project of potential translocation for colonisation by marine pests on the newly-formed artificial substrates or in disturbed marine habitats. The presence of a marine pest, *Musculista senhousia* (Asian date mussel) at the Project also requires consideration in biosecurity management to reduce the possibility of transferring this pest species to other locations via vessels leaving the Project.

Biosecurity risks associated with the operation of the Project could be reduced through the biofouling and ballast water management, surveillance and monitoring to detect marine pest introductions, and emergency response planning in the event that a pest species is discovered. Various international, Commonwealth, state and industry requirements and best practice guidelines are, however, presently available that provide instruction and guidance toward implementing best management practices.

For further information regarding marine pests and recommended management practices, refer to Appendix K and Section 7.

6.11.2.5 Noise

There are a number of potential effects that may arise as a result of elevated background noise levels. These can include limiting the detection by the mammals of natural sounds; disturbing their normal behaviour resulting in possible displacement from areas; and causing temporary or permanent reductions in hearing sensitivity (Baker, 2004). These potential effects depend to a degree on the type of marine mammal involved. The potential area or zone of influence of a man-made sound is also influenced strongly by the levels and types of ambient noise (Richardson et al., 1995).

The main source of project-generated noise during the operational phase of the Project is from vessel traffic. Sounds from moving sources (such as ships) are considered to be transient relative to the receivers. Underwater noise modelling has been undertaken for the main project activities that have the potential to result in effects on sensitive receptors. A descriptive analysis of each Project noise source, as well as Project-specific noise modelling, is provided in Appendix G. Based on the outcome of the underwater noise modelling, the predicted noise effects were compared to values known to cause behavioural disturbance or injury to marine mammals and marine fish. The assessment is based on those species previously identified (Golder 2009d and Golder 2011c) as being potentially present in the vicinity of the Project, together with a review of the available literature. The potential impacts on sensitive receptors from increased noise are summarised below.

Fish

Underwater noise generated from vessel traffic is not anticipated to exceed the injury threshold for fish during any phase of the Project. Predicted vessel noise may exceed the potential behavioral threshold of fish (150 dB re 1 uPa) for a distance up to 30 m from the source (vessel).

Marine Mammals

In regards to shipping, the noise generated from this activity generally dominates ambient noise at frequencies from 20 to 300 Hz; above 300 Hz, shipping sounds may or may not be significant depending on the level of wind-dependant ambient noise, and above 500 to 50,000 Hz, wind, wave and precipitation noise dominate. Frequencies used by marine mammals may overlap with frequencies produced by cargo ships and carriers which range from 10 to 1,000 Hz (Richardson et al., 1995). Lower frequency (10 to 100 Hz) emissions have been shown to influence large baleen whale behaviour, including humpback whales (Frankel and Clark, 2002).

Underwater noise from vessel traffic is not anticipated to exceed the injury threshold for pinnipeds or cetaceans during any phase of the Project. Predicted vessel noise may exceed the behavioral threshold for marine mammals (140 dB re 1 uPa - continuous) for a distance up to 115 m from the source (vessel). However much remains uncertain regarding the potential effects of vessel noise on marine mammals. 'Noise masking' and avoidance are primary effects to consider. Increases in noise levels within the same frequency band as sounds associated with communication, foraging, predator avoidance, and navigation can mask these signals, diminishing the distances over which marine mammals can detect them. The effects that such detection range reduction may have on individual reproduction or survival, and the actions marine mammals may undertake to avoid masking, are highly variable.

Research has demonstrated that vessel noise affects both the movement and acoustic behaviour of marine mammals (Richardson et al., 1995). While other cues, e.g., vision or pressure waves, may be available to animals during extremely close approaches, it is likely that most responses are acoustically mediated.

Acoustic responses to vessel noise include animals changing the composition of call types, the rates and duration of call production, and the actual acoustic structure of the calls. With regard to locomotory behaviour, demonstrable responses to both the opportunistic observations (i.e., transiting vessels) and experimental approaches have been reported for some species. Responses include changes in respiration rates, diving, swim speed, and these changes have, in some cases, been correlated with numbers of vessels and their proximity, speed and direction changes. Responses have been shown to vary by gender and individual.

Many odontocetes (toothed whales) show considerable tolerance of vessel traffic. Dolphins of many species often tolerate or even approach vessels, but at times members of the same species show avoidance. Reactions to boats often appear related to the dolphin's activity: resting dolphins tend to avoid boats, foraging dolphins ignore them, and socialising dolphins may approach. Toothed whales sometimes show no avoidance reaction to vessels or even approach them. However, avoidance can occur and may cause temporary displacement, but no clear evidence is available that toothed whales have abandoned significant parts of their range because of vessel traffic (Richardson et al. 2005).

Reactions of humpback whales to vessels vary considerably. Some humpback whales show little or no reaction when vessels are well within hearing zone of influence. When baleen whales such as humpbacks receive low-level sounds from distant or stationary vessels, the sounds often seem to be ignored. Some whales approach the sources of these sounds. When vessels approach whales slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance manoeuvres. In response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behaviour and swim rapidly away. Avoidance is especially strong when a boat heads directly toward the whale. Feeding humpbacks have been shown to be displaced temporarily by vessels. Although vessels caused short-term changes in behaviour including avoidance, some specific humpbacks remained for weeks in areas often used by vessels, and returned to the area in later years (Baker et al. 1988 and 1992).

Sea lions in the water tolerate close and frequent approaches by vessels, and sometimes congregate around fishing vessels. Sea lions hauled out on land are more responsive but rarely react until a boat approaches within 100 to 200 m (Bowles and Stewart, 1980). In general, evidence about reactions of seals to vessels is lacking. The limited data, plus the responses of seals to other noise human activities, suggest that pinnipeds often show considerable tolerance of vessels.

6.11.2.6 Light

Marine fauna are influenced by light in various ways exhibiting both and positive and/or negative phototactic responses (Depledge et al., 2010, McConnell et al. 2010, Marchesan et al. 2005). The response to light can be species as well as life-stage specific. Light is used for feeding, breeding and predator avoidance and therefore marine fauna behaviour may be impacted in various ways by the introduction of artificial light (Longcore and Rich, 2004). Responses to artificial light may include changes in behaviour, predator-prey dynamics, schooling, spatial distribution, migration, reproduction and changes in population dynamics.

A common reaction of fish to artificial light is to school and move towards or away from the light source. This reaction may facilitate feeding as well as the avoidance of predators. The attraction towards the light source has been shown to vary among fish species and can be related to phylogenetic and ecological factors and also differ according to light characteristics in particular, intensity and wavelength (Marchesan et al., 2005).

Marine invertebrates, such as zooplankton, exhibit diel migrations where they move up and down within the water column over a 24-hour period. Presumably this behaviour allows the zooplankton to forage in the dark conditions and thus avoid predators (Longcore and Rich, 2004). Artificial lighting has been shown to decrease the diel migrations in zooplankton, both in the range of vertical movement as well as the abundance of individuals migrating (Moore et al., 2000). Studies have shown naturally high predation of zooplankton by fish on nights of full moon. The zooplankton migrated to the surface after sunset, however due to the full moon, were subjected to a high predatory intensity because of the increased illumination. Increased illumination due to human activities is likely to mimic this response favouring the predator and consequently changing the predator-prey interactions (Longcore and Rich, 2004).

Some benthic fauna have planktonic larval stages that are photopositive allowing them to avoid benthic predators. Artificial lights may potentially affect the normal response to light and influence breeding patterns, as well as attract predators (McConnell et al. 2010).

There is little research on the impacts of artificial light on mammals. Longcore and Rich (2004) mention the increased predation by seals on salmon in the presence of artificial lighting. In regards to cetaceans, it is considered unlikely that there would be a significant impact due to localised artificial lighting associated with the Project as cetaceans predominantly utilise acoustic (rather than visual) senses to survey their environment.

As the area likely to be influenced by artificial lighting would be localised around the jetty area, the potential for negative impacts on marine environment from this source are considered to be low.

6.11.2.7 Fisheries

The initial assessment of environment effects considered the impact on fisheries from the perspective of whether there were any potential detrimental effects on commercial or recreational fish activities. It was concluded that fishing activities such as trawling, line fishing and netting were carried out in other regions of the gulf away from the proposed development, thus the creation of a port in this area would not impact on fishing activities. This conclusion can be further elaborated to infer that the development of this jetty would not significantly impact on the sustainability of the fishing stocks themselves, as no noteworthy fish populations occur within the vicinity of the Project (with the exception of Syngnathids, as discussed in the relation to seagrass habitats). In addition, the Project is located within the Port Neill Aquaculture Exclusion Zone, thus direct effects on mariculture activities are not anticipated.

The installation of a jetty out to the 20 m isobath has the potential to impose on commercial and recreational fishing grounds. A range of commercial fishing activity occurs in Spencer Gulf, including trawling for western king prawns, fishing for finfish and cuttlefish, and collection of abalone. Inspection of video footage taken during the marine field survey did not reveal obvious trawl marks in the sandy seafloor in the vicinity of the proposed port, but the sudden disappearance of seagrass deeper than 12-13 m is consistent with the area being the focus of some trawling activity. The main fishing activities are, however, not carried out in close proximity to the Project. Western king prawns are captured from waters in the region of Whyalla, Wallaroo, Cowell and in deeper channels (DEH, 2003), and the available literature does not include mention of prawn fishing in the region of Port Lincoln or neighbouring coastlines.

Line fishing and netting for finfish occurs throughout the gulf, however Tumby Bay (immediately south of Port Spencer) and Port Neill (to the north) are closed to net fishing (DEH, 2003), which suggests that commercial fishing activities may not be common practice along this coastline and in the region of the Project. Giant cuttlefish populations are typically concentrated in the northern Spencer Gulf near Lowly Point and are thus also likely to be out of the influence of the proposed Project.

Current literature indicates that the Spencer Gulf abalone fisheries cover the area from Port Lincoln to Cowell, which includes the Project area (DEH, 2003). The presence of abalone was noted during the survey but the fishery for this occurs elsewhere in the gulf, and particularly at Tiparra Reef and Cape Elizabeth. The impact of the proposed port on the abalone fishery in Spencer Gulf is therefore likely to be minimal overall.

Recreational fishing is also undertaken throughout the gulf; although, based on the available literature, the Project area is not noted as an area of intense recreational fishing. Thus the likelihood of the Project impacting on recreational activities would be similar to that of commercial fishing.

Overall, the effects of the installation and operation of the Project on fisheries and aquaculture facilities in Spencer Gulf should be no more than those experienced currently as a result of port facilities operating elsewhere in the region and are, therefore, considered to be minimal.

6.11.2.8 Localised Increased Fishing Pressure

Concerns were raised during 2011 public consultation regarding the potential for impacts associated with increased fishing pressure by foreign crews accompanying vessels. The concern raised was with particular regard to abalone species. However reef-associated fish species may also be susceptible to such impacts. Discussion is provided below as to the potential for impacts from increased fishing pressure at the Project. It is noted the Port would not allow fishing in or around the jetty.

Reef-Associated Fish

As reported above, Blue Throated Wrasse were the most abundant fish recorded during the surveys. Reef-associated wrasse species (such as the Blue Throated Wrasse) are of conservation concern, due to fishing-induced impacts on populations that are territorial, site-attached and have vulnerable population dynamics (Baker 2009, Shepherd et al., 2010).

Shepherd et al (2010) discussed some of the issues associated with the recreational fishing of Blue Throated Wrasse in parts of South Australia. If increased fishing activities were to occur, some localised impacts may occur in the immediate vicinity of berthed vessels and around the proposed jetty infrastructure.

Abalone

Haliotis laevis (Greenlip abalone) were found in the reef surveys (and also in the seagrass meadows fringing the reef areas). Abalone, particularly Greenlip, are vulnerable to fishing-induced population declines due to a number of population characteristics, such as their sedentary nature, ease of capture, small “home range”, localised reproduction and limited larval dispersal, variable growth between metapopulations (“stocks”), and variable fecundity and fertility between metapopulations (Shepherd et al. 1992, Rodda et al., 1998). It is anticipated that increased fishing pressure at the Project, if not managed, would lead to some localised impact to the Greenlip abalone (*H. laevis*) population.

6.11.2.9 Artificial Substrates

The development of the Project would result in the creation of artificial substrates. In marine systems, man-made structures such as seawalls, jetties and artificial reefs can provide habitat for a diverse set of marine biota. Although artificial structures can be detrimental to local marine ecosystems when first introduced, they can eventually become havens for marine life, resulting in increased abundance and diversity in the region. However, while studies show that artificial habitats generally support the same species as found on natural reefs, the assemblages between natural and artificial habitats usually differ (Clynick et al, 2008).

Artificial structures are also areas where fish tend to aggregate. Because of this, such structures are often assumed to be beneficial to fish populations. However, research investigating whether these habitats sustain viable populations of fish (or whether they just provide structures to which fish are drawn) suggests that artificial reefs act predominately as aggregating devices only and therefore could have detrimental effects on fish stocks by promoting targeted fishing (PIRSA, 2009).

The sub-tidal infrastructure associated with jetties typically includes pylons and pontoons and at times, additional infrastructure such as pipelines. These structures are common to estuarine and coastal areas throughout the world because they facilitate large-scale commercial and recreational boating (Holloway and Connell, 2002). Studies have shown that these structures also represent novel habitats for sub-tidal epibiota because the diversities and abundances of organisms develop differently between these habitats and rocky reef (Connell, 2001a).

The physical presence of hard structures in the area would provide attachment sites for sessile organisms such as sponges, sea squirts and macroalgae. Organisms colonising this new habitat would be likely be recruited from local communities, but there is also the potential for colonisation by non-indigenous marine organisms (e.g., *Carcinus maenas*, *Musculista senhousia*, *Sabella spallanzanii*) given the expected degree of marine vessel traffic to and from the area.

6.11.2.10 Sediment

Disturbance to sandy substrates from propeller wash has been identified as a potential source of impacts in the previous marine ecological assessments undertaken by Golder (refer Sections 6.10 and 6.11). In order to minimise turbidity and disturbance to sediments, operational measures have been proposed which would ensure that cargo vessels are not under their own power within 1.5 km of the jetty. Such measures would minimise the potential effects on the sandy substrate habitat.

Other potential impacts from the ongoing operation of the Project may include increased suspended particulates through loss of export material or accidental releases (if they occur). Operational measures would be implemented to minimise the potential for accidental loss of product and to reduce the risk of accidental releases into the marine environment.

In regard to increased sedimentation, hydrodynamic modelling indicates that some sedimentation may occur inshore of the berthing jetty, with increases to seabed levels predicted to be in the order of 0.03 to 0.05 m per annum (ASR, 2011).

Increased suspended particulates and sedimentation has the potential to interfere with the feeding mechanisms of filter feeding sessile invertebrates (such as the Razorfish, *P. bicolor*) which in turn could lead to increased mortality of the species at the Project site. There is also the potential for loss of seagrass and macroalgal communities due to decreases in water clarity and smothering but sedimentation.

Over time there may also be the potential for shipping related contaminants to accumulate in the sediment under the berthing jetty and surrounding the jetty. Some chemicals can be acutely toxic to organisms when introduced at concentration above natural background levels, while others can bioaccumulate or biomagnify over time. Given the sediments are sandy, and as the Project is situated on a moderately exposed coastline, the potential for accumulation is less than if the Project was situated in muddy, sheltered conditions.

6.11.3 Incidental Ore Spillage

The iron ore handled at the proposed Port facility would predominantly consist of the iron oxides hematite (Fe_2O_3) (with Stage 2, magnetite (Fe_3O_4)). These are very poorly soluble forms of iron.

Management controls would be in place to limit dust releases to the atmosphere and marine environment. However, consideration will also be given to accidental releases that could impact on the environment. Increases in suspended particulates could reduce light penetration and cause smothering of benthic organisms.

The rate at which dust particles settle out of the water column and settle on the benthos would depend on the particle size. Fine particles are likely to remain in suspension for longer, with greater potential for transport further afield, and greater potential for dissolution (should suitable environmental conditions prevail), than larger particles.

Work conducted by researchers at the University of South Australia for Centrex (Mallavarapu et al., 2008), into the solubility of iron ore in seawater support the view that these forms of iron would be poorly soluble in seawater and unlikely to result in increased primary production (or increased phytoplankton growth). Solubility calculations on an accidental release of iron ore (for the purpose of the study, a spill quantity of 75kg was nominated) could result in an increase in soluble iron by 1.5 ng/L. Considering the dissolved concentrations of iron in seawaters presented earlier and reported by Phippen et al. (2008), - 12.8×10^{-9} mg/L to 55.8×10^{-9} mg/L in surface Antarctic waters and Armstrong (1957) – 10 to 100 $\mu\text{g/L}$, this increase in soluble iron is of trace proportions.

This estimate of increased solubility is considered to be a conservative figure as the calculations also assumes discharge into a finite volume of water (50,000 m³), little dispersion, and little sedimentation.

The energy of the coastal environment is a major factor in determining the impacts of suspended solids and organic matter inputs. A high energy environment would significantly disperse organic particulates and bring in waters with increased dissolved oxygen levels. A moderate energy marine environment, such as at the Project, may be expected to flush out releases of particulates and organic matter, and introduce oxygen into surface waters from wave action. These prevailing conditions would help to mitigate adverse effects of releases of iron ore dust and small accidental releases to the marine environment surrounding the jetty (should they occur). However, the extent of impacts would be largely determined by the quantity of iron ore released and the frequency of the inputs.

After consideration of the prevailing moderate energy environment at the Project, the solubility of iron in the marine environment, and assuming iron ore releases (if they occur) are relatively small, the impacts to the marine environment are not expected to be significant. In addition the proposed Project design includes fully enclosed loading and unloading storage and handling facilities, refer Section 4. Further discussion regarding the potential for impacts to occur from dust and accidental releases of iron can be found in Appendix K.

6.11.4 Incidental Grain Spillage

Should accidental grain releases occur, it is the introduction of fine organic matter into the marine environment which could potentially have a greater impact on the marine environment rather than the grain itself. An increase in fine organic matter may result in the following:

- Decreased dissolved oxygen as a consequence of increased decomposition by microorganisms.
- Increased suspended particulates which reduce light penetration and can cause smothering of benthic species, and
- Increased growth of aquatic plants due to increased nutrient inputs. Nuisance growth of aquatic plants can result in algal blooms and associated toxic effects. In addition, when the plants die, there is a reduction in dissolved oxygen concentrations as the plants decompose.

Calculations on releases of grain into the marine environment at the Project have not been performed. Similarly, calculation on the quantity of fine organic matter in a specified quantity of grain has not been estimated. However, it is considered unlikely that an accidental spill of grain at the Project would result in an unacceptable environmental impact given that accidental releases would be readily minimised and mitigated, and proposed design including enclosed loading and unloading storage and handling facilities, refer Section 4. Further discussion regarding the potential for impacts to occur from accidental releases of grain can be found in Appendix K.

6.11.5 Spencer Gulf Oil Spills

Increased ship movements in the Spencer Gulf as a result of the Port have the potential to increase the risk of oil spills in the gulf. According to Australian Maritime Safety Authority records there have been 26 major oil spills in Australia from 1903 to 2010, three of which occurred in South Australia.

- Two of the major oil spills in South Australian were associated with oil loading activities at Port Stanvac, in the Gulf St Vincent.
 - No fuel or oil loading or unloading would occur at Port Spencer. Therefore there is no risk of oil spills associated with this activity.
- The third occurred at Port Bonython, in the northern Spencer Gulf, and was the result of a ship's bow rupture during berthing operations during high winds in 1992 (AMSA, 2010).
 - The Port is a deep water port and as described in Section 4.2.1, during rough seas (i.e., wind speed exceeding 40 knots or current speed exceeding 3 knots) ships will be moved from berth at the Port and anchored offshore to minimise the risk of ships grounding or impact to the wharf or vessel. The offshore anchorage is 4 km east of the coastline and has a minimum of 24 m depth of water for rough conditions water.
- The majority of major oil spills that have occurred in Australia have been associated with grounding as a result of high seas, poor weather conditions or uncharted reefs. Five spills (including the spill in the Spencer Gulf) have been associated with berthing incidents at wharves; again, a contributing factor to these berthing incidents was high seas and poor weather conditions.
 - A hydrographic study of the seabed would also be undertaken prior to Port Spencer operations to ensure suitable obstruction free shipping lane, therefore minimising the risk of ships grounding on uncharted reefs within the shipping lane.
 - Shipping movement through Spencer Gulf (particularly due to the size and depth of water required for Cape class vessels) would remain in existing shipping channels and would not be likely to involve shallow water or reefed areas.

The risk of oil spills in the Spencer Gulf as a result of ship movements to and from the Port is considered to be low, refer Section 7.2, and therefore detailed oil spill impact scenarios are not assessed within this PER.

6.12 Coastal Environment Sediment

This Section assesses existing oceanic environmental conditions with regard to potential changes in movement of sediment result from construction of the Project jetty, in consideration of the following:

- Extreme wind, wave and tidally driven currents
- Quantification of existing flow regime
- Existing sediment transport regime
- Scour effects due to jetty and associated piling

- Changes in flows due
- Project impacts on sediment transport, and
- Potential changes to local beach profiles.

To determine the changes in sediment movement while a vessel was at the jetty, the existing sediment movement was measured, and likely changes identified. These studies and the predicted impact on sediment transport can be found in the report presented in Appendix L.

6.12.1 Flow Regime and Wave Movements

A flow regime is a specific combination of the timing, size and duration of the flow of water and accounts for the way that marine sediment is moved. Movement of the ocean water around the Project is primarily due to tidal currents and wave induced currents. Potential changes to the flow regime are primarily driven by changes in local wave heights associated with the vessels moored at the jetty. With a vessel in the jetty, wave heights directly in the lee of the vessel would be reduced by an average of 0.4 to 0.7 m. Wave heights directly inshore of the vessel would be reduced by around 0.5 m. This would be offset by a slight increase in wave height to the north and south of the jetty.

The modelled impact of the presence of the vessel showed two joining circulating cells of water in the lee of the jetty. The maximum change in wave induced currents modelled is less than 0.15 m/s. Maximum changes would occur at either side of the headland directly inshore of the jetty.

To determine the potential effects of the Project on the movement of sediment, an estimate was taken of the length of time vessels may be moored at the jetty. The moored days were estimated to be a total of 48 days for Cape class vessels and 16 days for Panamax vessels, equating to approximately 20% of the year.

6.12.2 Movement of Sediment

Movement of sediment is due to a combination of waves, tidal currents and wave induced currents. In this location, tidal currents by themselves are not strong enough to move sediment in large volumes. Breaking waves and currents created by waves can disturb the lying sediment, which then can be moved by the tidal currents. Models were produced to provide an overview of the interaction of the waves and tidal/wave driven currents. The approach taken was to analyse the volume movement of sediment as the volume of sand moving per metre per unit of time. Simulations were undertaken of the same period of time both with and without a vessel in the jetty, which showed how erosion of the sea bed would change. The results were split into two categories:

- Gross transport rate, which is the sum of the absolute quantities of sand that are suspended., and
- Net transport rate, which is the vector averaged quantities of transported sediment.

In the presence of a vessel, both gross and net transport rates drop to nearly zero in its lee, where very little wave energy penetrates. Therefore, it was predicted the impact would be a decrease in the movement of waves, and therefore a decrease in the amount of sediment moved in the lee of the vessel. At the south of the jetty, the actual movement of sediment would slightly increase. The volume movement of sediment was analysed by taking into consideration the time predicted a vessel would be berthed at the jetty. It was therefore approximated the change in the sea bed level in the lee of the vessel could range from 0.03 metre/year (m/y) to 0.05 m/y.

6.12.3 Beach Impact

The environmental effects modelled show that jetty construction and operation would only affect the immediate local area around the jetty. Based on sediment transport modelling the area of Rogers Beach immediately north of the jetty would be expected to show insignificant change in net erosion rates. The current erosion rate is estimated to be 0.190 metres/year (m/yr) and subsequent to Port development it is estimated the net erosion rate would be 0.189 m/yr, refer Appendix L. Areas of Rogers Beach that experience net accretion of 0.147 m/yr under existing conditions may experience slightly reduced accretion rates to 0.139 m/yr. Over time this was estimated at up to 0.35 m less sand on the beach over a 50 year period. Given that these areas of the beach are predicted to accrete with time, the nett effect on beach width is expected to be minimal (Oldman, *pers. comms.*, 2012).

It is predicted that the small pocket beach immediately south of the jetty may experience reduced net erosion rates. The current erosion rate is estimated to be 0.121 m/yr and subsequent to Port development it is estimated the net erosion rate would be 0.115 m/yr. Over time this is estimated to cause up to 0.3 m more sand on the beach over a 50 year period. The extra volume of sand on the beach will be small compared to the natural variation in erosion and accretion cycles that will occur at this beach (Oldman, *pers. comms.*, 2012).

Lipson Island and Lipson Cove Beach, located approximately 1.5 km south of the jetty, are not expected to experience change to current sediment transport, and beach deposition and erosion, arising from the Port's operation.

6.12.4 Scour Holes

Modelling showed that scour holes would form in the area immediately surrounding the jetty, the predicted depth ranging from 0.3 m to 1.4 m. This analysis showed there would not be any interference or accumulative effects of pile scour holes at the Project. Due to the keel clearance for even fully loaded Cape class vessels (i.e., minimum 2 m), the pile spacing and the relatively localised effects on flows, the formation of scour holes is unlikely to have any detrimental effects on vessel movement or manoeuvrability. It was also shown the potential increase in depth around each pile due to scour would have minimal impact on wave moments and therefore no effect on the beach.

6.13 Heritage and Native Title

No sites, as defined under the *Aboriginal Heritage Act 1988*, listed on the Register of Sites and Objects occur within the proposed disturbance footprint of the Project area. Similarly, there are no areas or sites under the protection of the Commonwealth *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* within the Project area.

Nevertheless, the Project area does have mythological and ethnographic significance to the local Traditional Owners. This includes the dreaming storyline that covers the wider area, and the historical walking trails that criss-cross the landscape. Furthermore, outside the Project area, a number of sites of significance to the Barngarla and Nauo people occur (Haines, 2008).

Unregistered areas of Indigenous archaeological significance occur in the dunes adjacent to Rogers Beach, to the north-east of the Project area. This coastal fringe, including the cliff top/headland in the immediate vicinity of the proposed jetty, represents the most sensitive in terms of heritage. This includes the waterholes identified on early exploration and cadastral maps of the area (Figure 5-13), which may have some level of cultural significance and mythology attached. All these sites are outside of the Project footprint.

Therefore, based on the current knowledge of the Indigenous heritage values of the Project area, it is anticipated that no impacts would occur to Indigenous sites of archaeological, anthropological or other significance. However, this assessment is based only on a literature review and brief reconnaissance of the area, with limited on-ground sampling having been undertaken. Consequently, a thorough physical inspection of the Project area would be undertaken prior to construction, in consultation with the local Traditional Owners, to ensure no sites or objects of Indigenous heritage would be impacted.

Sites of non-indigenous heritage do occur within the disturbance footprint of the Project area. None of these are listed on the South Australian Heritage Register, or are recognised by the Department of Environment and Natural Resources, or the District Council of Tumby Bay. The site of a former water reserve, as shown on early mapping and located within the Project area, is located approximately 600 m inland of the proposed jetty. This site would be impacted by the Project. Similarly, the former stock route would be impacted.

The shearing shed and yard complex, located adjacent to Swaffers Road (Figure 5-13) may be impacted by the upgrade of Swaffers Road. The wreck of the *Three Sisters* is located on the beach at Lipson Cove, over 1 km south of the Project area. No impacts are anticipated to affect this site. No other known sites of non-indigenous heritage would be impacted within the Project area.

6.14 Visual Aesthetics

This section provides a description of the predicted impacts of the Project on the visual aesthetics. The purpose of the visual amenity assessment is to assess potential impacts of the Project on visual amenity at construction, operations and decommissioning phases and to recommend mitigation measures for residual impacts.

6.14.1 Assessment Approach

Information sources used for the visual amenity assessment included the following:

- Aerial image and contour data sourced from Department of Environment and Heritage, South Australian Government
- Site data and landscape modelling images
- Contour data sourced from Centrex Metals Ltd, February 2011, and
- Non-georeferenced photographs from various viewpoints taken by Centrex and Golder staff.

The visual amenity study area (VSA) is defined in Figures 6-7 and 6-8. The VSA includes Lipson Cove Beach, Rogers Beach, roughly 4 km off the coast, and roughly 500 m west of Coast Road.

6.14.1.1 Viewshed Modelling

Viewshed modelling identifies areas across a landscape that can be seen from one or more observation points or lines. The viewshed model highlights areas that potentially would be able to view the Project. The viewshed model identifies all vantage points on the landscape and is the main data source to choose Key Observation Viewpoints (KOV).

Viewshed modelling was performed using ArcGIS v. 10.0, a Geographic Information System (GIS), and the 3D Analyst extension. The modelling technique was limited to topography only and did not account for vegetation. The predominant vegetation of the Project area is characterised with shrubs and grasses and would minimally affect the viewshed model. As no vegetation data was available, the resulting model depicts a scenario with more visual impact than one with vegetation data. If vegetation heights were modelled, it is probable that the Project visibility would be reduced. The viewshed analyses the view from points located along the top of the tallest, most visible Project components such as the silos and jetty.

Although the viewshed analysis does account for earth curvature, it does not consider atmospheric conditions, distance, size or contrast. As a result, rather than being used to determine the impact, the viewshed models are used to identify areas that are potential impacted. The viewshed map (Figure 6-9) illustrates the potential regional visual impact of the Project.

Following the viewshed modelling, KOVs were selected at locations with a line-of-sight to the Project and based on the following combination of factors:

- Accessibility to the public and ease of access
- Location that is used by recreational users, and
- Potential for views over larger portions of the landscape.

The seven viewpoints chosen as to assess the visual effects of the Project are on Rogers Beach (VP-1), Spencer Gulf (approximately 1km from jetty) (VP-2), Lipson Beach (VP-3), Lipson Cove Road (VP-4) and Swaffers Road (VP-5). These locations are illustrated in Figure 6-9.

6.14.1.2 Landscape Analysis and Modelling

The existing landscape was rated based on scenic quality and user sensitivity at each key viewpoint. Scenic quality was rated based on landforms, vegetation, water, colour, adjacent scenery, scarcity and cultural modifications. Photos taken by Golder and Centrex staff, aerial imagery and the modelled views from the key viewpoints were used as a basis for this assessment. The use of photographic or modelling techniques to identify viewer preference for landscape scenery and thus scenic quality is a widely used and well supported methodology (Hull and Stewart 1992; Stewart et al 1984; Zube 1982). User sensitivity was rated based on type of users, amount of use, public interest, adjacent land uses and special areas (USDI, 1986a).

Following the viewshed modelling and identification of key viewpoints, a 3D software package, 3D Studio Max, was used to create predictive perspective images to determine the visual impact of the Project from KOVs. A specific landscape model was produced and provided images from these KOVs.

The model incorporated the Project infrastructure, satellite imagery, vegetation along Lipson Cove Road and a digital elevation model (DEM).

6.14.1.3 Contrast Rating

The effects on scenic quality are measured by the visual contrast created between the Project and the existing landscape at each key viewpoint. Modelled views of the Project at the operational phase were used as a basis for this assessment. The operational phase was used as the “worst case” scenario. The contrast is rated according to the following visible elements:

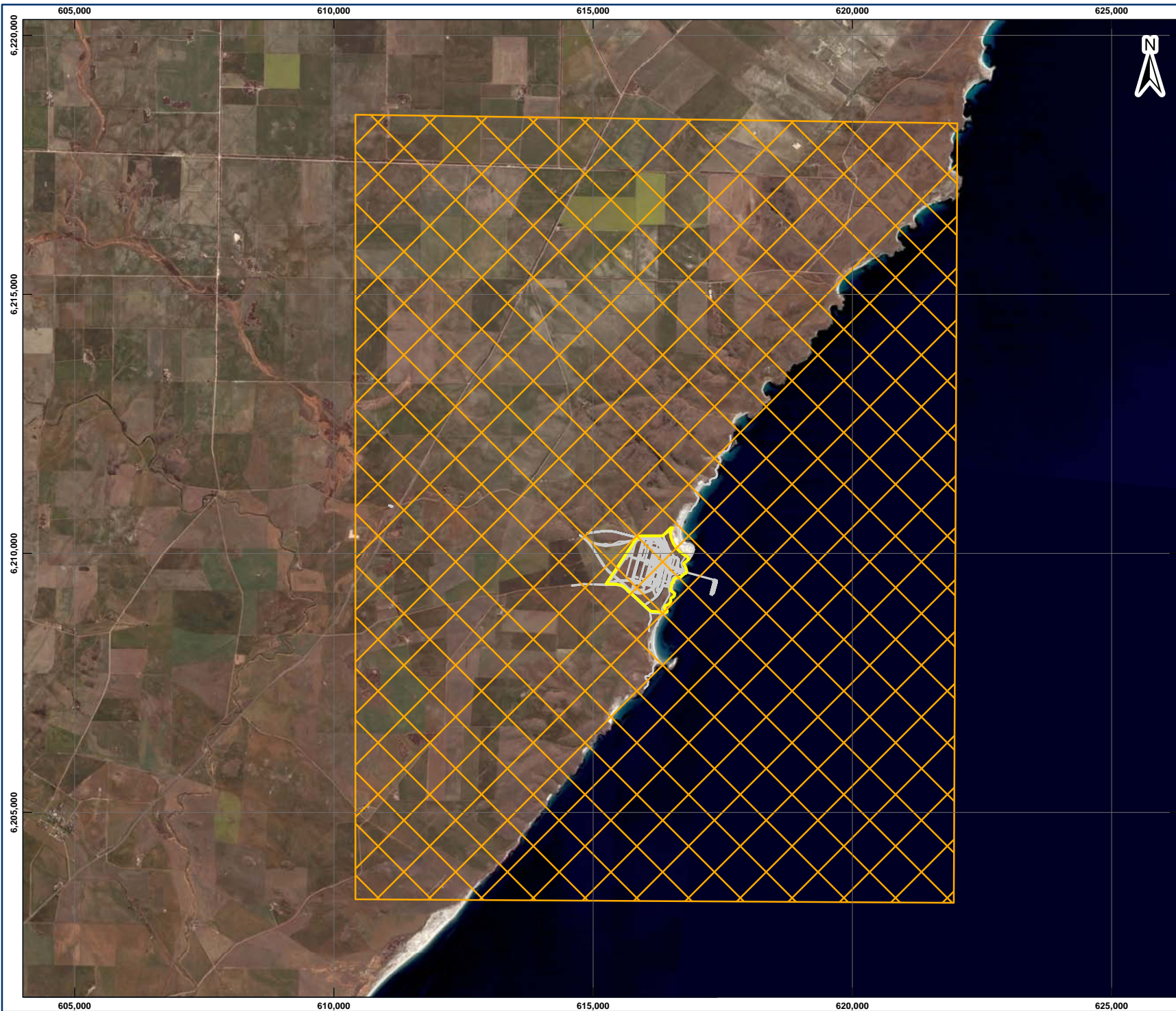
- Form, which includes the sub elements of structures and movement, relates to the shape of disturbances in contrast to the existing landscape shapes.
- Line, which relates to the path the eye naturally follows when perceiving differences in landscape shape, colour or texture.
- Colour, which relates to the degree that the sub elements of hue (e.g. red, blue, green), value (e.g. brightness) and chroma (e.g. saturation) contrast with existing landscape colours.
- Texture, which relates to the patterns that exist within larger landscape elements., and
- Scale, which relates to the proportional size of the object in relation to the field of view of the camera.

6.14.1.4 Residual Impact

The results of the contrast rating represent the overall contrast between all of the Project elements and the existing landscape. The overall contrast for the KOVs are compared to the initial landscape rating as shown in Table 6-6, resulting in the residual impact significance of the KOVs and for the Project.

Table 6-6: Residual Visual Impact Significance Criteria Guide


Overall Project Contrast	Baseline Case Landscape Rating		
	Low	Medium	High
Negligible	Negligible	Negligible	Negligible
Low	Low	Low	Moderate
Moderate	Low	Moderate	High
High	Moderate	High	High




VISUAL AMENITY STUDY
AREA

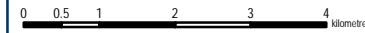


LEGEND

-  Visual Amenity Study Area
-  Project Boundary

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 (c) 2010 Microsoft Corporation and its data suppliers
 Aerial image sourced from Bing Maps, date sourced 28.11.2011.
 Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011.
 Township data sourced from MapInfo Street Pro.



SCALE (AT A4) 1:100,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 6-7



610,000

620,000



6,210,000

6,210,000

610,000

620,000

PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

VIEWSHED MODEL FOR
SHIPPING VESSEL



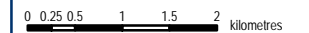
LEGEND

-  Shipping Vessel Viewpoint (Approximately 4 km off shore)
-  Viewshed - Visible
-  Project Boundary

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(c) 2010 Microsoft Corporation and its data suppliers
 Aerial image sourced from Bing Maps, date sourced 28.11.2011.
 Township data sourced from MapInfo Street Pro.
 Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011, Lidar contour data sourced from Centrex Metals Ltd, February 2011 and SRTM 90m Digital Elevation Data sourced by NASA.



SCALE (AT A4) 1:80,000

DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 6-8



VIEWSHED AND
VIEWPOINT LOCATIONS



LEGEND

-  Landscape Model Viewpoints
-  Viewshed – Visible
-  No Viewshed Analysis Performed (Lidar contours only elevation source input)
-  Project Boundary

COPYRIGHT

bing
 (c) 2010 Microsoft Corporation and its data suppliers
 Aerial image sourced from Bing Maps, date sourced 28.11.2011.
 Township data sourced from MapInfo Street Pro.
 Aerial image sourced from Department for Environment & Heritage, South Australian Government, 2007.
 Site data sourced from Parsons Brinckerhoff, Drawing No: 2172612A-CIV-0003 Rev C, Drawn By: JMc, Drawing Date: 15.08.2011. Lidar contour data sourced from Centrex Metals Ltd, February 2011.

0 125 250 500 750 1,000 metres

SCALE (AT A4) 1:45,000
 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 6-9



6.14.1.5 Assumptions and Limitations

The effects of an aesthetics disturbance can vary greatly depending on the sensitivity of the landscape and the observer. The viewshed model used to determine the visible areas from the Project depicts an additional visual impact due to not modelling vegetation and illustrates Project visibility from the two beaches (i.e., Rogers Beach and Lipson Cove Beach), the ocean, and areas along Lipson Cove Road and Swaffers Road, although Project visibility ends west of Coast Road.

At locations where disturbances are visible and sensitive observers are likely to be present, the potential for an effect exists. At key locations around the Project, viewpoints were created and modelled. The existing conditions were evaluated and then compared to modelled views that incorporated the Project disturbances. The Project disturbances include the grain silos, jetty, ship loader, conveyors, shipping vessel, and other facilities.

The existing environment landscape was rated based on scenic quality and user sensitivity with both factors combined into a landscape rating. The landscape rating was generally determined to be low to medium with the exception of Lipson Cove Beach where the user sensitivity is predicted to be higher and a “high” rating was assigned. The landscape rating of medium was assigned to the Project area.

A determination of the Project’s probable effects was made, based on the overall contrast between the Project’s components and the existing landscape of the Baseline Case. The Project contrast averages out as a low rating for the five locations and the viewshed mapping illustrates that many onshore areas outside of the beaches would have limited or no visibility of the Project. As a result the contrast rating of low was assigned to the Project. Using the Residual Impact Significance Criteria Guide (refer Table 6-6), an overall low impact was assigned in the assessment of the potential effects of the Project on visual amenity.

Assumptions and limitations include the following:

- The viewpoint camera was set at a height of about 2 m above the modelled ground surface to reflect the maximum height of a pedestrian.
- Views were generated using a clear sky and no atmospheric influence on visibility (i.e. no haze or fog), since this provides the best visibility and thus the “worst case” for visual aesthetics.
- Night-time views were not created. Lighting for the onshore and offshore facilities would use domed focussed low level lights. The Project’s infrastructure would require lighting during the night to ensure safe and efficient operations. The lighting from the structures could be visible from several viewpoints. However, due to the lack of information on detailed Project design, the impact of lighting has not been quantified in this assessment.
- Infrastructure heights varied from 4 m to 30 m above ground or sea level.
- The operational phase was the only phase in which viewshed and landscape modelling was used.
- GIS (Geographic Information System) analysis was conducted using ArcGIS 10.0 Desktop.
- A Cape class vessel was shown moored at the jetty for the operational phase as it is the largest vessel expected, and there would be approximately 12 Cape class vessels (or 27 Panamax vessels) per year for ore for Stage 1 of the Project., and

- Visualisation images do not show all vegetation from KOVs nor were images of the existing landscape captured.

6.14.2 Construction Phase

The Project infrastructure would be built during the construction phase and many facilities would not be visible to the viewers. The visual impact was not modelled for this stage rather focused on operations phase. It is likely there would be a slight visual impact of the jetty and buildings being constructed as well as equipment and machinery in the laydown area.

6.14.3 Operational Phase

6.14.3.1 Landscape Rating

The baseline landscape was rated based on scenic quality (Tables 6-7 through Table 6-11) and user sensitivity (Table 6-12 through Table 6-16). These factors were combined into a landscape rating. The resulting ratings for each KOV are summarised in Table 6-17.

Table 6-7: Scenic Quality Ratings VP-1 (Rogers Beach)

Scenic Element	Rating Categories			Rating	Rationale
	High	Medium	Low		
Landform	5	3	1	3	Low, subdued topography with few interesting features.
Vegetation	5	3	1	2	Some variety of vegetation, but limited to a few types.
Water	5	3	0	5	Water is predominant feature.
Colour	5	3	1	5	Vibrant colours with beach, water, and outlying vegetation.
Adjacent scenery	5	3	0	1	Adjacent scenery is not visible.
Scarcity	5	3	1	3	Scenery is fairly common to the region.
Cultural modifications	2	0	-4	2	No modifications in sight.
Total				21	
Score^(a)				High	

^(a) Low = 0 to 11, moderate= 12 to 18, high = 19 or higher (USDI, 1986b).

Table 6-8: Scenic Quality Ratings VP-2 (Ocean)

Scenic Element	Rating Categories			Rating	Rationale
	High	Medium	Low		
Landform	5	3	1	1	View from ocean.
Vegetation	5	3	1	1	View from ocean.
Water	5	3	0	5	Water is predominant feature.
Colour	5	3	1	2	Low variation of hues, but not a dominant scenic element.
Adjacent scenery	5	3	0	5	Adjacent scenery is nearby land.
Scarcity	5	3	1	1	Scenery is fairly common to the region.
Cultural modifications	2	0	-4	2	Very minor modifications, farming in background.
Total				17	
Score ^(a)				Moderate	

^(a)Low = 0 to 11, moderate= 12 to 18, high = 19 or higher (USDI ,1986b).

Table 6-9: Scenic Quality Ratings VP-3 (Lipson Cove Beach)

Scenic Element	Rating Categories			Rating	Rationale
	High	Medium	Low		
Landform	5	3	1	5	Topography has interesting features, Lipson Cove.
Vegetation	5	3	1	2	Some variety of vegetation, but limited to a few types.
Water	5	3	0	5	Water is present and noticeable.
Colour	5	3	1	5	Vibrant colours with beach, water, and outlying vegetation.
Adjacent scenery	5	3	0	3	Adjacent scenery is visible.
Scarcity	5	3	1	3	Scenery is fairly common to the region.
Cultural modifications	2	0	-4	2	No cultural modifications.
Total				25	
Score ^(a)				High	

^(a)Low = 0 to 11, moderate= 12 to 18, high = 19 or higher (USDI, 1986b).

Table 6-10: Scenic Quality Ratings VP-4 (Lipson Cove Road)

Scenic Element	Rating Categories			Rating	Rationale
	High	Medium	Low		
Landform	5	3	1	1	Low, subdued topography with few interesting features.
Vegetation	5	3	1	2	Some variety of vegetation, but limited to a few types.
Water	5	3	0	0	No water visible.
Colour	5	3	1	3	Low variation of hues, but not a dominant scenic element.
Adjacent scenery	5	3	0	1	Adjacent scenery is barely visible.
Scarcity	5	3	1	1	Scenery is fairly common to the region.
Cultural modifications	2	0	-4	-2	Roads, farming, and some houses in area.
Total				6	
Score ^(a)				Low	

^(a)Low = 0 to 11, moderate= 12 to 18, high = 19 or higher (USDI, 1986b).

Table 6-11: Scenic Quality Ratings VP-5 (Swaffers Road)

Scenic Element	Rating Categories			Rating	Rationale
	High	Medium	Low		
Landform	5	3	1	2	Low, subdued topography with few interesting features.
Vegetation	5	3	1	3	Some variety of vegetation, but limited to a few types.
Water	5	3	0	0	Open water is dominant landscape feature.
Colour	5	3	1	2	Low variation of hues, but not a dominant scenic element.
Adjacent scenery	5	3	0	1	Adjacent scenery is barely visible.
Scarcity	5	3	1	1	Scenery is fairly common to the region.
Cultural modifications	2	0	-4	-2	Roads, farming, and some houses in area.
Total				7	
Score ^(a)				Low	

^(a)Low = 0 to 11, moderate= 12 to 18, high = 19 or higher (USDI, 1986b).

Table 6-12: Visual Sensitivity Ratings VP-1 (Rogers Beach)

Sensitivity Element	Rating	Rationale
Type of user	high	Recreational users of the beach could be highly sensitive to visual changes.
Amount of use	medium	One road (Swaffers Road) with relatively low traffic, recreation area.
Public interest	medium	This has been raised as an issue of concern during public consultation.
Adjacent land uses	low	Adjacent land has similar characteristics.
Special areas	medium	Location near Rogers Beach.
Overall sensitivity	medium	No comment.

Table 6-13: Visual Sensitivity Ratings VP-2 (Ocean)

Sensitivity Element	Rating	Rationale
Type of user	medium	Maritime passengers could be moderately sensitive to visual changes; Commercial boats would have low sensitivity and recreational boats would have higher sensitivity.
Amount of use	medium	The ocean can potentially have many passengers, varying overtime.
Public interest	medium	This has been raised as an issue of concern during public consultation.
Adjacent land uses	low	Adjacent land has similar characteristics.
Special areas	low	No special area known.
Overall sensitivity	medium	Potential impact would vary over time to reflect shipping movements.

Table 6-14: Visual Sensitivity Ratings VP-3 (Lipson Cove Beach)

Sensitivity Element	Rating	Rationale
Type of user	high	Recreational users to the beach could be highly sensitive to visual changes.
Amount of use	high	One road (Lipson Cove Road) with relatively high traffic, major recreation areas; More visited than other local beaches since campsite present.
Public interest	medium	This has been raised as an issue of concern during public consultation.
Adjacent land uses	low	Adjacent land has similar characteristics.
Special areas	high	Location near Lipson Island Conservation Park.
Overall sensitivity	high	Due to Lipson Cove tourism use, overall sensitivity is considered higher.

Table 6-15: Visual Sensitivity Ratings VP-4 (Lipson Cove Road)

Sensitivity Element	Rating	Rationale
Type of user	medium	Users travelling to Lipson Cove Beach and residents.
Amount of use	medium	Lipson Cove Road is used by residents and recreational users travelling to Lipson Cove Beach.
Public interest	medium	This has been raised as an issue of concern during public consultation.
Adjacent land uses	low	Adjacent land has similar characteristics.
Special areas	low	No special areas considered for this location.
Overall sensitivity	low	No comment.

Table 6-16: Visual Sensitivity Ratings VP-5 (Swaffers Road)

Sensitivity Element	Rating	Rationale
Type of user	low	Users travelling to Rogers Beach and residents.
Amount of use	medium	Travellers on Swaffers Road and Coast Road; some travellers may be travelling to Rogers Beach.
Public interest	medium	This has been raised as an issue of concern during public consultation.
Adjacent land uses	low	Adjacent land has similar characteristics.
Special areas	low	no special areas considered for this location.
Overall sensitivity	low	No comment.

Table 6-17: Visual Aesthetic Summary

Viewpoint	Scenic Quality	Sensitivity	Landscape Rating ("average" of scenic quality and sensitivity)
VP-1 Rogers Beach	high	medium	medium
VP-2 Ocean	moderate	medium	medium
VP-3 Lipson Cove Beach	high	high	high*
VP-4 Lipson Cove Road	low	low	low
VP-5 Swaffers Road	low	low	low

*Note: a high rating is related to consideration of the area as a tourism asset.

6.14.3.2 Contrast Rating

The modelled views were generated that represent the operation phase. The modelled views are represented in Figures 6-10 to 6-14. The contrast rating was conducted for the operations phase to capture the maximum effect of the Project (i.e. Cape size vessel was included in assessment). All viewpoints have a view of at least the onshore facilities and four of the viewpoints (VP-1 through VP-4) have a few of the offshore facilities (i.e. ship loader, vessel or jetty). VP-1 illustrates a clear view of the onshore facilities. VP-4 and VP-5 would have direct views of the road upgrades but a minor visual impact would be the result.

Table 6-18 provides the visual contrast ratings for each contrast element for each of the viewpoints. The landscape contrast elements of form, line, colour, texture and scale were evaluated for each viewpoint and disturbance type. Disturbances were separated into land/water, vegetation and structures categories. The degree of contrast of each disturbance type was evaluated separately for each contrast element and an overall contrast rating was assigned for each viewpoint. The overall contrast rating is generally the average of all applicable contrast ratings; however, if a single element or the cumulative effect of the elements combine in such a way that the view is dominated by the change then the overall rating may be adjusted accordingly.

The possible contrast ratings are negligible, low, moderate and high. The contrast rating “none” was assigned where the disturbance type is not visible in the modelled view. The contrast rating “low” was assigned where the disturbance type is visible in the view; however, the level of contrast with the surrounding landscape elements is low. The contrast rating “moderate” was assigned where the disturbance type provides a noticeable contrast to the surrounding landscape; however, the view is not dominated by that contrast. The contrast rating “high” was assigned where the disturbance type contrasts with the surrounding landscape elements in such a way that it dominates the attention of the viewer. As an overall contrast rating, the rating “negligible” was assigned to contrast elements that have one “low” rating only. The landscape and contrast rating are then combined to assign significance to the visual impact for each viewpoint. The results are presented in Table 6-19.

Figure 6-10: Viewpoint from Rogers Beach (VP-1) Looking Towards the Project



Source: PB, 2011

Figure 6-11: Viewpoint from Ocean (VP-2) Looking Towards the Project



Source: PB, 2011

Figure 6-12: Viewpoint from Lipson Cove (VP-3) Looking Towards the Project



Source: PB, 2011

Figure 6-13: Viewpoint from Corner of Lipson Cove Road and Coast Road (VP-4) Looking Towards the Project



Source: PB, 2011

Figure 6-14: Viewpoint from Swaffers Road (VP-5) Looking Towards the Project



Source: PB, 2011

Table 6-18: Visual Contrast Ratings

Viewpoint	Contrast Element	Land/Water	Vegetation	Structures	Overall
VP-1 Rogers Beach	form	low	none	high	moderate
	line	low	none	high	moderate
	colour	none	none	moderate	moderate
	texture	none	none	moderate	moderate
	scale	low	none	high	moderate
	Overall Contrast for VP-1:				
VP-2 Ocean	form	none	none	moderate	moderate
	line	none	none	moderate	low
	colour	none	none	moderate	low
	texture	none	none	moderate	low
	scale	none	none	moderate	moderate
	Overall Contrast for VP-2:				
VP-3 Lipson Cove Beach	form	none	none	low	low
	line	none	none	low	low
	colour	none	none	low	low
	texture	none	none	low	low
	scale	none	none	low	low
	Overall Contrast for VP-3:				
VP-4 Lipson Cove Road	form	none	none	low	low
	line	none	none	low	low
	colour	none	none	low	low
	texture	none	none	low	low
	scale	none	none	low	low
	Overall Contrast for VP-4:				
VP-5 Swaffers Road	form	none	none	none	negligible
	line	none	none	low	low
	colour	none	none	none	negligible
	texture	none	none	none	negligible
	scale	none	none	none	negligible
	Overall Contrast for VP-5:				

Table 6-19: Operations Phase Visual Amenity: Impacts Significance Rating

Viewpoint	Overall Contrast	Landscape Rating	Magnitude of Effect
VP-1 Rogers Beach	moderate	medium	moderate
VP-2 Ocean	Low	medium	low
VP-3 Lipson Cove Beach	Low	high	moderate
VP-4 Lipson Cove Road	Low	low	low
VP-5 Swaffers Road	negligible	low	negligible

6.14.3.3 Shipping Vessel Travel

A definition of the potential viewshed of the shipping vessel travel was conducted using GIS analysis for 4 km from the offshore facilities. This was considered to reflect the intent to potentially park shipping vessels 4 km offshore during rough weather conditions. Figure 6-8 illustrates this potential viewshed of the vessel 4 km offshore within the VSA. The vessel would be visible from the ocean, along the coast including Rogers Beach and Lipson Cove Beach, and some areas further inland. Although the vessel would not be a constant feature of the viewshed, the vessel would appear in the foreground-middleground distance zone of the potential offshore viewer. This distance zone is an area where activities might be viewed in detail. The impact of the shipping vessel at this distance is highlighted in Table 6-20. Shipping vessels are not expected to be present at the 4 km location for extended periods of time regularly and their presence would be based on actual Port needs should rough weather or a situation arise where offshore parking is required.

The visual impact from offshore locations within the VSA would be less as the vessel is further away from the viewer. The shipping vessel docked on the jetty and nearest to offshore viewers would present the scenario for maximum visual impact. No predictive perspective images were created for this scenario.

Table 6-20 Ship Viewshed Summary

Viewshed	Project Visible Area [ha]	Percent of VSA
Visible	8,425	50
Not Visible	8,414	50
Study Area	16,839	100

6.14.4 Decommissioning Phase

The visual impact during the decommissioning phase would not be as severe as for the operational phase. A shipping vessel would no longer be a temporary feature of the viewshed. The impacts of the onshore and offshore facilities would be similar to those during construction. The visual impact for this stage was not modelled.

6.15 Socio-Economics

The Project presents a range of potential socio-economic impacts and opportunities for the communities closest to the development, the Eyre Peninsula region and the South Australian economy. This section assesses these impacts. At a broad level, the Eyre Peninsula region is in transition from its traditional reliance on agriculture and ocean-based industries to a potential new era of mineral resource development.

Centrex is committed to opening up the Eyre Peninsula to the benefits of a strong resources-based industry, but understands the importance of balancing this development with existing communities and industries, particularly agriculture, aquaculture and tourism. Considerable time and effort has been spent by Centrex engaging with key stakeholders including community representatives of the key towns, Tumby Bay, Lipson and Port Neill.

A baseline study of socio-economic issues was completed in 2009 (refer Section 5.15). During 2011, a comprehensive program of stakeholder engagement was undertaken (refer Section 1.4). Throughout this process and the gathering of other baseline environmental data, Centrex has developed an understanding of how to approach the Project in a way that would harness the skills of local communities, develop opportunities for local businesses and respect the lifestyle and values enjoyed by residents of the Lower Eyre Peninsula.

An important factor in considering the impacts of the Project was the relationship between its likely progress and the development of hematite and magnetite projects in the region. While the Project also has the potential to service agriculture by providing an export facility for grain, its viability is dependent on the development of the region's iron ore prospects, particularly Centrex's projects at Wilgerup, Bungalow, and around Koppio (Project Fusion). As a result, the assessment conducted has also considered information gathered for a baseline macro-economic study and an environmental and social report for one of the projects geographically closest to the Project, that is, the Carrow magnetite project (ACIL Tasman, 2011 and Coffey, 2011).

6.15.1 Key Community Concerns

The Centrex approach to Project community consultation has demonstrated the company's commitment to establishing relationships with the community where the Project would operate, listening to community concerns and actively responding to feedback in a timely manner. Information about Port related consultation can be found in Section 1.4. For the purposes of this section, it is important to highlight key community concerns relating to socio-economic impacts which, along with the Guidelines, have helped to guide the identification of issues.

Community questions were documented by Centrex with the release of a public Stakeholder Response Report (Appendix B) following community consultation sessions held in Port Neill, Tumby Bay and Port Lincoln in the first half of 2011. Questions and concerns raised by visitors to the open house information sessions were recorded by project team members. These enquiries were later published, with responses from Centrex for public information purposes. 2011 community feedback and concerns that are considered relevant includes the following:

- Traffic impacts from construction and operation of the Project
- Continued informal public access to Rogers Beach
- Potential environmental impacts to Lipson Island and beach areas close to the Project

- Visual impacts from the Project
- Potential impacts on power and water services to the Lower Eyre Peninsula arising from the Project
- Employment opportunities, and
- Business opportunities.

6.15.2 Economic Viability

The long term economic viability of the Project is dependent on the simultaneous development of hematite and magnetite projects in the region. Centrex and its joint venture partnerships have direct interests in projects at various stages of exploration and feasibility studies across 16 proven iron ore tenements on the Eyre Peninsula. While the Project would provide grain export infrastructure, its construction and operation would only be viable if at least one of the magnetite mining projects currently under review is developed. Centrex's Wilgerup hematite mine, about 21 km south-east of Lock and approximately 125 km from the Project by road, has recently been approved by government. Wilgerup would be the hematite source for Stage 1 of the Project.

Correspondingly, the capacity of the iron ore projects would be simultaneously constrained without the development of the Project. This is because there are no other South Australian ports currently capable of receiving Cape class vessels which are required by the potential mine projects to export hematite and magnetite in economically viable quantities. Other transport options for the prospective Eyre Peninsula mines are limited to the export points summarised in Section 2.

The projected life of mining for current Centrex or joint venture partnership mining projects is in excess of 20 years and the design life of the Project is 50 years. The experience of regions such as the Pilbara, where iron ore was first developed in the 1960s, shows that port infrastructure has required expansion rather than contraction in recent decades. The viability of the Project is also bolstered by its multi-user approach from the outset, which would allow the possibility of multiple industries benefiting from the asset. Agriculture would be the initial beneficiary as grain export facilities at the Project could relieve pressure at Port Lincoln and provide an alternative export site to farmers in the Lower Eyre Peninsula.

Table 6-20 summarises the quantities of ore and grain proposed to be shipped from the Project following each stage of development and their associated value (based on 2011 prices). The construction of the Project would include potential savings for state and local government (i.e. Tumby Bay District Council) primarily associated with related infrastructure costs and upgrades. These are summarised in Table 6-21. Estimates described as savings represent capital costs Centrex would fund as part of Project development. There are no major projected infrastructure costs for the state or local governments at this time as part of the Project.

Table 6-21: Expected Value of Products to be Exported from Port Spencer Stages 1-4

Port Development Stage	Estimated date of Completion	Estimated Quantity of Product for Export	Expected Economic Value of Export Products (AUD)*
1	Late 2014	<ul style="list-style-type: none"> ▪ 2 million t hematite ▪ 500,000 t grain 	\$AUD357 million
2	Late 2015	<ul style="list-style-type: none"> ▪ 5 million t magnetite ▪ 2 million t hematite ▪ 1 million t grain 	\$AUD1.1 billion
3	TBC	<ul style="list-style-type: none"> ▪ 10 million t magnetite ▪ 2 million t hematite ▪ 1 million t grain 	\$AUD1.7 billion
4	TBC	<ul style="list-style-type: none"> ▪ Up to 20 million t magnetite ▪ 2 million t hematite ▪ 1 million t grain 	\$AUD2.9 billion

*These value estimates are based on 2011 iron ore spot price of approximately \$AUD120 per tonne and 2010 (ABARES) export price for wheat of \$AUD234.89 per tonne.

TBC=to be confirmed

6.15.2.1 Financial Strategies

The expected total capital expenditure for constructing the Project is approximately \$AUD250 million ($\pm 30\%$). This expenditure would include construction of the jetty, conveyor system, road upgrades and earthworks to provide vacant blocks for the construction of appropriate grain and hematite sheds by prospective users. The estimated cost is subject to change as aspects of the design are developed further.

Centrex has sound financial strategies to ensure relevant infrastructure is in place for each stage of the development. The proposed approach to financing is an equal joint venture partnership with Wuhan Iron and Steel Company Limited (WISCO), the third largest steel maker in China and the fifth largest steelmaker in the world. WISCO is State-owned and funding for the Project is likely to come from State-owned Chinese banks. Centrex is an Adelaide-based company and would fund the remaining 50% of the projected costs through conventional sources of debt and equity.

6.15.2.2 Potential Costs and/or Savings for Infrastructure Expansion

The construction for the Project would include potential savings for state and local government (i.e. Tumby Bay District Council) preliminary associated with related infrastructure costs and upgrades. These are summarised in Table 6-22. Estimates described as savings represent capital costs Centrex would fund as part of Project development. There are no major projected infrastructure costs for the state or local governments at this time as part of the Project.

Table 6-22: Potential Development Costs or Savings to State and Local Government

Infrastructure Type	Cost or Saving to State or Local Government	Estimated Cost (AUD)	Benefit/Impact
Transport network upgrade: <ul style="list-style-type: none"> ▪ Swaffer’s Road (sealing) ▪ Lipson Cove Road (sealing) 	Neutral	\$AUD5.1 million \$AUD1.9 million	Improved public vehicle access to Lipson Cove campsite.
Electricity <ul style="list-style-type: none"> ▪ 27 km new transmission lines 	Neutral	\$AUD20 million	Additional user to retail power grid. Possible future upgrade to network due to additional demand.
Water <ul style="list-style-type: none"> ▪ Extension of mains pipeline to Project 	Neutral	\$AUD3.65 million	Additional user for potable water supply.
Sewerage <ul style="list-style-type: none"> ▪ Eco-tanks 	Neutral	\$AUD63,000	Re-use for irrigation would reduce mains water consumption.
Fire Services <ul style="list-style-type: none"> ▪ Tanks and pump system 	Neutral	\$AUD1.7 million	Available for State Emergency Service use.
Total	Neutral	\$AUD32.4 million	Overall contribution to strategic Stage and regional development goals.

Source: Centrex Metals Ltd, 2011

6.15.3 Employment and Investment Opportunities

The Project is expected to employ a peak construction workforce of more than 200 people and an operational workforce of up to 70 people, comprising 30 who would be directly employed to operate the Project and up to 40 who would likely be employed by the operators of the grain and hematite operations on-site.

Apart from direct employment opportunities, the Project can also be expected to create indirect opportunities for employment through the placement of contracts with local suppliers and subsequent increases in their projected turnovers creating a need for additional staff positions. Other indirect opportunities could be created at linked mining projects, including some which would only reach full capacity if the Project is available for ore export.

A likely example of direct economic opportunities would be the operation of a proposed construction village¹⁵, to be developed on the outskirts of Tumby Bay. This village would house the construction workforce for Port Spencer with an expected peak of 200 personnel. It is also anticipated this village would be expanded to accommodate the construction workforce required for the development of the mine proposed by the Eyre Iron Joint Venture, should an economic operation be defined. This would expand the village at peak to approximately 1,000 workers. A large percentage of the workforce is expected to be fly in/ fly out during construction. Part of the village may be retained in the long term for operations fly in /fly out staff, however Centrex would also look at options to encourage employees to relocate permanently.

Centrex is likely to contract out the management of this facility to an operator, who would in turn require a team of staff to deliver operational services such as administration, catering, cleaning and maintenance. The village would likely represent a long-term business opportunity. Further information about housing and accommodation during each phase of the Project is provided in Section 6.15.4.

As discussed previously, the confirmed development of the Project would provide certainty for a number of prospective minerals projects on the Eyre Peninsula. Access to an export port that is able to receive Cape class vessels would influence the feasibility of several projects, and as a result, open up the region to a future that includes a resource-based economy. The presence of additional mine and construction workers in Tumby Bay would be expected to have flow-on effects for established businesses as workers patronise their retail outlets or other services. Some local businesses may in turn need to hire more staff and increase their own spending to meet local demand, further adding to the economic growth of the towns and the region.

The overall economic impacts to the region would be positive, primarily because of the flow-on impacts the Project would have to prospective mine developments. The Project's operational workforce and primary impacts may be small, but the strategic location of the export infrastructure would likely lead to further economic opportunities.

Preparation of a South Australian Industry Participation Plan is not a required element of the PER, since this Project is wholly privately funded and therefore exempt from the requirements of the corresponding policy (ICNSA, 2005). Nonetheless, Centrex understands the principles of the policy and supports its intent of employing local people and businesses where appropriate and would be developing its own policy that reflects this.

¹⁵ The development of this accommodation village would be subject to its own development application (DA) within state and local government frameworks and as such would require a separate socio-economic assessment to fully understand the potential social and economic impacts of such a facility. Impacts assessed within this PER are related to the Project's Stage 1 development only.

6.15.4 Construction Phase

The construction of the Project is expected to be sub-contracted to two construction firms: an on-shore construction firm and a specialist marine construction company to build the jetty. These contractors would in turn employ on-site workforces. The total construction timetable is estimated to be 27 months, with earthworks potentially to start in September 2012, dependant on regulatory approvals. A secondary construction project would proceed in parallel to the Project to build the necessary worker accommodation consisting of a high quality village attached to Tumbay Bay. Discussions are under way with the Tumbay Bay District Council, to agree a potential site. The construction village would be subject to its own development application. This Section provides an overview of the expected socio- economic impacts for the construction phase.

6.15.4.1 Employment and Training

Based on current estimates, the Project is expected to employ a peak construction workforce of 213 people. Early construction would start with approximately 30 people on site undertaking earthworks and increase as Project construction commences. Most positions would require some previous experience or certificate qualification for undertaking construction work. About 2% of positions could be filled by people with no experience or certificate training. An example of the types and numbers of positions expected to be available during the peak construction period is provided in Table 6-23. The table is not a complete list of forecast positions.

Table 6-23: Forecast Employment Available During Peak Construction Phase

Employment Positions	Estimated Number Required in 2013	Employment Positions	Estimated Number Required in 2013
Construction Manager/s	3	Electrician	20
Materials /ore handling manager/s	2	Electrical distribution trades worker	3
Engineering Manager/s	2	Crane, hoist and lift operator	5
Health/Safety and Environment Manager	1	Bulk materials handling plant operator	8
Supervisor/team leader/s	4	Earthmoving plant operator	20
Surveyor/mine surveyor/s	3	Fitter and turner	5
Electrical engineer	3	Plumber	5
Mechanical engineer	6	Sheetmetal tradesworker	20
Civil engineer	5	Welder	10
Electrical technician	2	Metal fabricator	20
Apprentice fitter: instrumentation	2	Structural steel construction worker	20
Apprentice fitter: mechanical	2	Cleaner	4
Trainee (other)	2		

Source: Centrex Metals Ltd, 2011

Centrex is committed to employing local residents where possible and has stated that 100% of available positions would be available for appropriately skilled locals. In reality, though, baseline data shows significantly lower unemployment in the Eyre Peninsula region than South Australia as a whole. Tumby Bay and Port Neill also have proportionately older populations with many residents retired and self-employed (refer Appendix N). Given the acknowledged skills shortage affecting infrastructure and resources projects Australia-wide, it is unlikely the construction of the Project would be able to source a significant number of workers from nearby towns or the Eyre Peninsula region (ACIL Tasman, 2011).

Responsibility for meeting the Project's requirements for staff would rest with the Centrex-appointed contractors, but it is expected the majority of workers would operate on a fly in/fly out basis. Centrex would require its appointed contractors to investigate recruitment of local people with the appropriate skills. For example, local trades people, heavy vehicle operators and plant operators may be able to fill positions during the construction phase.

Preliminary workforce planning has identified some positions which would require all employees to have relevant experience to be considered for the work. Some positions have been identified for a possible mix of experience and skill level. For example; of the 20 sheet metal trades workers forecast for employment in 2013, 75% would be required to have experience but 25% could be inexperienced. These projections demonstrate Centrex's intention to create opportunities for unskilled, semi-skilled and skilled workers living locally.

6.15.4.2 Housing

The rental and short-term accommodation market in Tumby Bay and Port Neill does not currently have capacity to house the expected influx of workers at its peak (refer Appendix N). Current workforce projections would see more than 200 workers needing accommodation for up to a year. Centrex is in preliminary discussions with the Tumby Bay Council for a proposed purpose built accommodation facility and a potential council-owned site has been identified close to the airport. The proposed site is approximately 2 km from the town centre and hence provides some separation from the existing permanent residents. The majority of the construction workforce would be bussed to and from the construction site. This location is also close to existing power and water mains. The recently sealed airstrip offers potential to fly in/fly out construction workers. Tumby Bay Council has recently upgraded the town effluent treatment plant and this now has sufficient capacity to accommodate the proposed construction village.

The construction village would be composed of single bedroom type units with self contained ensuite facilities in each unit. The units would be laid out to include covered areas between groups of units. Materials used for construction of the units would be chosen to ensure the village fits into the local surroundings as much as practicable. The village would have its own recreational facilities, wet mess, kitchen and cook and internet facilities.

While most needs would be taken care of within the village, it is expected that workers would also interact with the local community and patronise local businesses as they choose. Alcohol consumption would be permitted at the village, but workers would be subjected to a zero tolerance policy and compulsory breath testing at the beginning of each shift.

At the end of proposed construction (2014) it is expected the village would continue to be needed to service fly in/fly out workers staffing developing mining projects in the region. The development of this village would be subject to its own development application within state and local government frameworks and as such would require a separate socio-economic assessment to fully understand the potential social and economic impacts of such a facility. Impacts assessed here are related to the Project's anticipated workforce only.

6.15.4.3 Electricity

During the construction phase electricity is expected to be provided by on-site diesel generators. Discussions are underway by Centrex with electricity infrastructure provider, ElectraNet, to reach an agreement that would see Centrex fund an extension of existing power lines. It is unlikely the additional infrastructure would be available until construction is completed. More information about the ElectraNet expansion is discussed in Operational Phase section below.

6.15.4.4 Water

It is proposed water would be delivered to the site through a mains water supply, which has been agreed in principle with SA Water. Centrex would pay for the necessary extension to have the water pipeline run from the Swaffers Road and Lincoln Highway intersection to the Project. The focus of current discussions relate to the method of payment for this infrastructure. Possible arrangements include an upfront payment to cover capital costs or regular premiums charged on top of the Project's water consumption to recoup SA Water's infrastructure outlay. The anticipated water use during construction is 1 ML per day.

Water security on the Eyre Peninsula is an ongoing issue for authorities. Up to 85% of potable water is sourced from groundwater and the majority is from one aquifer, Uley South (EPNRMB, 2011). SA Water has a long term plan for water security on the Eyre Peninsula (SA Water, 2008) that outlines the need for an additional key water source in 2014.

Centrex is aware of the demands for water on the Eyre Peninsula and has built in measures to minimise use of mains water. These include harvesting stormwater on site to use for dust suppression and other construction requirements. Water use during construction is estimated to be 1 ML per day for the duration of earthworks (approximately 8-10 months). Much of this water would be required for dust suppression and compaction. When earth works are completed, water use would reduce to approximately 250 kL per day until construction is completed. Further information about water resourcing during operations is provided in Operational Phase section below.

6.15.4.5 Local Businesses

Baseline data for Tumby Bay and Port Neill shows a strong reliance on agriculture and tourism as industry bases for the towns (refer Section 5.15). Local businesses in Tumby Bay include a small supermarket, a post office, two small hotels, a general grocery store and restaurants. Port Neill currently has a licensed hotel and small retail stores. The existing retail and services based in these towns primarily cater for local farmers, retirees and a seasonal influx of tourists.

Expected impacts during construction would include an increased demand for day to day trading at established businesses as more potential customers would be present within townships. Initially, there would be demand for short stay accommodation during the construction of the accommodation village; which would have flow-on impacts for restaurants and other shops and services. The injection of potential customers can also be expected to encourage new businesses to open, therefore widening the choice and opportunities for existing residents. Regionally, the construction of the Project is expected to increase demand for air travel to the Peninsula and potentially benefit Port Lincoln-based businesses who may be involved in the handling of people and supplies requiring transport to the Project.

A study commissioned in 2011 identified potential constraints for businesses wanting to act as local suppliers for the Carrow mine site, which can be extrapolated as common to the construction of the Project. An identified challenge is the ability to efficiently source goods and services from local businesses when there may be a lack of suitable experience and labour supply issues. Labour retention may also be a potential impact for local businesses which may not be able to compete with higher salary and work conditions available at hard-to-staff construction projects. This may be a particular incentive for younger workers and in turn create vacancies for local employers looking to provide services to the emerging mining and related port industries (ACIL Tasman, 2011).

The study report recommends the Carrow mine creates a business register for local suppliers and contractors as a method of creating opportunities increasing local capacity to meet the mine's requirements. The register allows local businesses to tender for available work, or parts of work, according to their experience and capacity. In this way, local suppliers start to build a relationship with the new industry and may work their way up to fulfilling bigger contracts (ACIL Tasman, 2011). Such a register could also be established for the construction and/or operations for the Project.

Regionally, businesses can also expect to benefit from the Project's construction. Suppliers not available locally may be sourced from the Eyre Peninsula Region or, more broadly, from South Australia, creating flow-on economic benefits.

6.15.4.6 Local Support Services

The Project's construction contractors would provide day-to-day medical and welfare services to the workforce. First aid personnel, a medical room with a bed and first aid supplies would be provided on-site. Transport buses for staff would be provided to and from the construction site, thereby reducing the amount of traffic on the roads and the likelihood of single driver accidents. However, the additional people and construction activity can be expected to create additional demands on existing medical and emergency services, such as police, ambulance and state emergency services, in the case of a serious injury, illness or workplace accident. As a benefit the Project supports the retention of these local support services in rural communities.

The nearest hospital facility with 24 hour accident and emergency service is at Tumby Bay. A larger hospital with accident and emergency service is located at Port Lincoln. The only police station locally is at Tumby Bay with one police officer on staff (refer Section 5.15). A State Emergency Service (SES) crew is also based at Tumby Bay.

There are no anticipated impacts on education services during the construction phase.

For more information on Centrex's proposed mitigations to minimise impacts on these services, refer Section 7.

6.15.4.7 Social Profile

Baseline data for Tumby Bay and Port Neill shows population growth rates have been lower than the Eyre Peninsula region and South Australia as a whole. There were more couples with no children in the Tumby Bay District Council area than other household compositions and a greater percentage ratio of men (51.1%) to women than SA (49.2% males) (refer Section 5.15).

While more women are being employed in construction, particularly in the professional services associated with construction, the industry is still predominantly staffed by men. The construction stage of the Project is likely to result in a further increase in the percentage of males residing in Tumby Bay and Port Neill and a likely increase in households with no children. The median age of people residing in the towns would be expected to decrease from the current age of 47 (compared with 39 in SA) (refer Section 5.15). The construction workforce is expected to be mostly younger than an average age of 47.

Some further social impacts are typically attributed to sudden increases of young men. Some of these impacts are anecdotal rather than based on research, but a recent social assessment conducted on six towns (some of them former agricultural towns) in Queensland's Bowen Basin has described the following:

- More itinerant workers: people moving in and out in search of better positions.
 - This can be anticipated for the Project as opportunities for employment expand with the growing economy and developing industries on the Eyre Peninsula.
- Increased rent: due to workers choosing to share private accommodation rather than live in company-supplied housing and the potential to increase local rental competition or rent speculation by landlords.
 - This is less likely to be a concern for the Project. The peak period of construction, when most work would be active, is expected to be approximately 12 months. It is not anticipated that construction workers would choose to seek private accommodation for this relatively short timeframe., and
- Economic benefits flowing to regional centres instead of the town where the Project is based: due to workers leaving the location to spend earnings in bigger commercial destinations (Petkova et al, 2009).
 - This may be expected for the Project. Port Lincoln offers the largest regional centre, with more established commercial and hospitality facilities. Adelaide is within one hour's travel by air. The structure of fly in/fly out rosters would influence the scale of potential flow on effects to regional centres.

Other social impacts such as increased alcohol and drug misuse and higher rates of violent incidents have been found to be associated with fly in/fly out workforces. Though the most significant of these trends have been found in remote mining camps, rather than established towns where construction villages have been added (Carrington et al, 2010). For information on how Centrex proposes to influence worker behaviour refer Section 7.

6.15.4.8 Traffic

Baseline traffic conditions and potential impacts have been assessed as part of this PER. Traffic is of particular concern to local and regional stakeholders, particularly residents of the towns of Tumbly Bay and Port Neill who currently use Lincoln Highway on a regular basis.

Swaffers Road would be constructed as a haul road for heavy vehicles at the beginning of the construction period, enabling it to be used as a dedicated route for heavy vehicles. Construction workers would be transported to site by bus, minimising the number of individual vehicles travelling to and from site. Centrex has committed to pay for road upgrades including sealing and widening Lipson Cove Road and Swaffers Road and installing right-hand turning lanes on Lincoln Highway. For more information on traffic impacts and proposed mitigations, refer Section 6.7. The Lincoln Highway is gazetted for use by road trains and B-double vehicles.

6.15.4.9 Visual Amenity

Visual impacts during construction would be limited to the period of works and include the presence of earth moving equipment, construction materials and construction equipment. The visual impacts would be temporary associated with this phase of the Project. For more information on visual impacts refer to Section 6.14.

6.15.4.10 Noise and Dust

In 2011 an environmental noise assessment was undertaken for the Project and recommendations put forward for projected noise impacts during construction (refer Appendix G). Noise is expected to be created by on-site generators used for power, construction machinery, earthmoving equipment and vehicle movements in and out of the site. Potential receptors for the noise impacts include nearby residents and fauna. For more information about noise impacts refer Section 6.6. Dust generation during construction would be expected in some form as part of earthmoving works. For more information on proposed mitigations on both these issues refer Section 7.

6.15.4.11 Environment

Environmental impacts for both the on-shore and marine environments have been assessed as part of this PER. As discussed in Section 6.15.1, community consultation feedback highlighted concern about potential environmental impacts relating to the following:

- The marine environment, including the seabed
- Lipson Island birdlife, and
- The condition of the beaches, particularly Rogers Beach.

The effect of the Project on terrestrial, and Lipson Island and marine ecology is assessed in Sections 6.9, 6.10 and 6.11, respectively.

6.15.4.12 Operational Phase

Based on the current estimated start date of 2012, the Project is expected to be operational by the final quarter of 2014. From 2015 onwards, approximately 30 people would be employed to manage the Project and an additional 40 would be expected to be employed by the companies operating the hematite and grain facilities on-site. Centrex anticipates engaging an experienced contractor to oversee all Project management and operations. Staff would be employed by the operator rather than Centrex. This Section provides an overview of the expected impacts for the operational phase.

6.15.4.13 Employment and Training

The Project is expected to require about 30 full time staff for operations. An additional 40 are expected to be employed by the hematite and grain operators on-site as part of material transport and handling. Extra truck drivers would also be required to transport product to the Project. In most cases up to four people would need to be employed for each operational position. This is to cover three shifts over a 24 hour period and includes one person who would be on a break.

Centrex, and its contractors, would open all positions to local people where their skills and experience meet the requirements of the positions. In reality though, Centrex does not expect to be able to fill all the required positions from people living locally. A summary of the forecast positions and numbers required for operations is presented in Table 6-24.

Three apprentice and two trainee positions are expected to be available once the Project is operational. Centrex's contractors would seek to place local people into these training positions.

Table 6-24: Forecast Workforce Profile for Operations Phase

Position	Estimated Workforce Number Required in 2015	Position	Estimated Workforce Number Required in 2015
Operations Manager	1	Instrumentation Technician	1
Materials/Ore Handling Manager	3	Mechanical Technician	4
Engineering Manager	0.5	Electrician	4
Health, Safety & Environment Manager	1	Instrumentation Fitter	1
Maintenance Manager	1	Nurse	1
Supervisor/Team Leader	4	Office Manager	1
Accountant	1	Waste Water or Water Plant Operator	4
Human Resource Professional	1	Weighbridge Operator	4
Training and Development Professional	1	Cleaner	1
Electrical Engineer	1	Apprentice Electrician	1
Mechanical Engineer	1	Apprentice Fitter: Instrumentation	1
Water & Tailings Specialist	1	Apprentice Fitter: Mechanical	1
Community Liaison/Engagement Professional	0.5	Trainee	2
Electrical Technician	1	Tug boat crew (3 tugs)	9
Laboratory Technician	1	Total	69.5

Source: Centrex Metals Ltd, 2011

6.15.4.14 Housing

It is expected Project staff would primarily live in surrounding local communities, if they are not already residing in the region. The proximity of the Project to towns including Tumby Bay, Port Neill and Port Lincoln would make it feasible for staff to live in any of these locations, or the surrounding rural region, without a significant commute to work.

The size of the projected workforce during operations means expected impacts on local housing stocks or the rental market are expected to be negligible.

Low unemployment rates and competition for labour would make it difficult for Centrex to attract staff to the required positions from existing residents in the region. To mitigate this, up to half of the Project employees are expected to work on a fly in/fly out basis and, while on shift, would reside at the accommodation village built for the construction period.

Project staff would be expected to make their own choices about where they live, dependent on their personal and family circumstances. Centrex is confident, however, that the Lower Eyre Peninsula's existing townships have significant benefits to offer families and workers who might consider relocating to be closer to their work. This is especially the case for workers who could be otherwise deployed to remote locations where there is no opportunity to resettle their families. As these towns have seen only incremental increases to their populations in recent years, any permanent new residents linked to a new major employer is expected to bring positive effects.

6.15.4.15 Electricity

Centrex is currently in negotiations with South Australia's electricity infrastructure provider, ElectraNet, to install an additional 27 kilometres of transmission lines, which would allow the Project to be connected to the main power grid. The planning and logistics for this expansion is at least a 12 month project, which means the connection is unlikely to be available until the Project is operational. The cost of the additional infrastructure (approximately \$AUD20 million) would be paid for by Centrex. The exact nature of this financing is currently under discussion and is likely to be one of two options, Centrex (or the Centrex-WISCO joint venture) would pay the capital cost upfront or ElectraNet would build, own and operate the line and build the capital cost into power usage costs over the next 20 years.

6.15.4.16 Water

Estimated water usage during operations is 250 kL per day. Water would be supplied to the Project through a mains connection, following the extension of the pipeline in time for construction. Stormwater would also be harvested for reuse on site to a capacity of 160 ML. An environmentally advanced water treatment system would be used to allow for reuse (i.e. irrigation purposes) of all waste water and eliminating any discharge to the marine environment.

Centrex is aware of ongoing pressures regarding water security for the Eyre Peninsula region. Mains water is sourced from groundwater drawn from the Uley South aquifer which is replenished through rainfall and sensitive to changing climactic conditions (EPNRMB, 2011). Design principles for the first stage of operations have worked to minimise water usage and allow for reuse.

This assessment relates only to the issues raised during the first stage of operations. Future development applications would address Stage 2 of the Project development when Centrex plans to construct a desalination plant to meet water requirements for processing magnetite on-site. It is estimated 1GL of water would be required per 1 million tonnes of concentrate produced each year.

6.15.4.17 Local Business

Impacts on local business during operations are expected to be moderate and positive. Some retailers and local suppliers could benefit from direct business contracts with the Project's operating company. These could include contracts for catering, office supplies, gardening or maintenance services. Others would benefit indirectly from potential new residents in the towns and the flow-on impacts of more people being in employment with the capacity to spend money locally.

The economic constraints identified and discussed in the context of the Project's construction above, would not be as applicable during operations. In particular the capacity of local suppliers is a potential constraint for big projects developing on the Peninsula. The size and scale of the operating Project should not make it difficult for local suppliers to capitalise on any opportunities, but demand from other projects developing at the same time could make the Project a lower priority.

6.15.4.18 Tourism

Tourism is currently the second most significant industry for Tumby Bay and Port Neill, after agriculture. The towns play host to a seasonal influx of visitors and some homes are dedicated private holiday residences. The towns are valued for their quiet seaside lifestyle and easy access to fishing, boating, sailing, diving and bushwalking (Tumby Bay District Council, 2011). Each town has a selection of short stay accommodation for visitors and welcomes people travelling by caravan and camper van.

The operation of the Project is expected to have minimal effect on the tourism industry and associated activities for Port Neill and Tumby Bay. Separate accommodation for Project workers would minimise impacts on established tourist accommodation in the towns. The Lipson Cove campsite, to the south of the Project, would continue to operate and access to Rogers Beach, to the north, would be maintained. The Project is unlikely to negatively impact recreational activities such as fishing, diving, sailing or bushwalking. Fishing would not be allowed at the jetty or working waters area.

Small scale positive impacts would include better road access to the Lipson Cove campsite and Rogers' Beach due to the widening and sealing of existing roads.

6.15.4.19 Local Services

Impacts on local services such as medical facilities, the police and other emergency services are expected to be minor. The Project would have a relatively small workforce and its operators would put in place a high standard of health and safety procedures to prevent accidents and injuries wherever possible.

The Project would also have its own on-site fire service consisting of a fire main around the sheds and along the jetty with fire hydrants ready for the connection of hoses. The fire main would have a diesel generator and water storage tanks. Centrex has already established stakeholder relationships with the Tumby Bay branch of the State Emergency Service and SA Police. Commitments have been made to maintain open communication and host appropriate drills and training when the Project is operational.

A potential positive impact for the Project's operational phase would be the chance that additional permanent residents arising from operations workforce in townships could increase enrolments at local schools. This is unlikely to occur during construction but as the Project reaches operations, it is more likely some employees would relocate their families to the two nearest towns of Tumby Bay and Port Neill. Baseline data has shown Tumby Bay has strong enrolments while Port Neill has struggled to sustain itself as enrolments have declined.

6.15.4.20 Social Profile

The Project's operational phase is unlikely to impact on the social profile of Tumby Bay and Port Neill. If 10 to 15 of the anticipated 30 workers are sourced from the local employment pool, another 15 may be employed on a fly in/fly out basis. These statistics are unlikely to alter baseline demographics.

The biggest change to the local profile would be the introduction of a new large industry and local employer. Tumby Bay and Port Neill have long provided the civic and social support for agriculture and tourism. The operation of the Project has potential to diversify this economy and open up new opportunities which, over time, could encourage younger people to stay in the area or return home after long absences. The new opportunities could also entice new residents and their families to the region. For example, there may be scope for more small retailers, contractors and suppliers to service the Project directly or the industries using the Project. Existing businesses may also find their turnovers benefit from a more consistent stream of income than the fluctuations they experience are used to from tourism and farming.

6.15.4.21 Traffic

Traffic impacts during operation are expected to consist of 140 ore truck movements a day (to and from the site), when the Project is operating at its peak. Another 70 truck movements each day would be attributable to grain deliveries. This activity would be seasonal, with more trucks delivering to the Project (up to 140 movements) during harvest than other times of the year (MY&A, 2011). Magnetite from possible future mine development would be transported to site using underground slurry pipelines and therefore no additional road transport would be associated with this activity.

Product would be delivered via Lincoln Highway, which is gazetted for road train and B-double vehicle use. All heavy vehicles would use Swaffers Road from Lincoln Highway, which would be in place from the first stages of construction. There would be no interaction between heavy vehicles and light vehicles (which would use Lipson Cove Road to access the Project). Details about road upgrades, including right hand turning lanes, are provided in Section 4.8 and in the traffic impact assessment (Section 6.7).

The strategic location of the Project has taken into account traffic impacts for communities of the Lower Eyre Peninsula. Specifically, an operating Project at Port Spencer would reduce grain truck movements through Port Lincoln that are already a community concern. The location, with its own access to Lincoln Highway via Swaffers Road also prevents traffic impacts through established towns. An early transport option for the Wilgerup mine was to develop mineral exporting facilities at Port Lincoln (SKM 2008). This option raised significant concern on the part of Port Lincoln residents who did not want to see an increase in truck movements through the town.

6.15.4.22 Visual Amenity

A separate visual amenity study has been completed and is presented in Section 6.14. Design principles used for the site layout of the on-shore infrastructure have sought to minimise visual impacts. This has included locating on-shore infrastructure on the lowest parts of the Project area to take advantage of natural landforms.

6.15.4.23 Noise and Dust

The development of the Project would create a new industrial hub where there has been little previous activity. This may have impacts on neighbouring residences (farmhouses) and members of the public using the Lipson Cove campsite and accessing Rogers Beach. The area for on-shore infrastructure has previously been used for agricultural pursuits, which may have involved the movement of stock and some farming equipment. The Project would increase activity to regular movement of vehicles, movement of product (i.e., ore and grain), and operation of machinery and infrastructure.

Centrex has undertaken studies to understand the impacts and levels of disturbance that are likely to occur, particularly in relation to noise and dust. Design features have been built into early planning of the Port to try to minimise these impacts. Sections 6.5 and 6.6 provide an assessment of the effects of the Project on noise and dust levels respectively.

6.15.4.24 Environment

Effects of the Project on terrestrial ecology, Lipson Island and marine ecology are presented in Sections 6.9, 6.10 and 6.11, respectively. As discussed previously, 2011 community consultation showed there was concern about potential environmental impacts relating to the following:

- the marine environment, including the seabed
- Lipson Island birdlife, and
- the condition of the beaches, particularly Rogers Beach.

Public access to Rogers Beach would be maintained throughout construction and operation. The Project development would not impact on designated aquaculture zones, the nearest of which surround the Port Neill township.

6.15.5 Decommissioning Phase

The Project has a design life of 50 years and a projected operating life in excess of 20 years, if linked to the expected operating lives of prospective Centrex mines. However, the experience of other major industrial ports shows the infrastructure is usually updated and maintained to operate much longer than first anticipated. The potential for other industry on Eyre Peninsula to use the multi-user facility remains, and would further add to the possible life of Project.

The following provides a list of possible social and economic impacts and opportunities arising from decommissioning though due to the expected 20 year or more life of the facility this would be reviewed as part of planning for decommissioning. The significance or scale of these potential impacts would vary substantially from 2011 to at least 2031 and therefore only an outline of possible impacts is provided. A detailed assessment of social and economic impacts arising through closure of the Project would be completed at least five years before decommissioning. Potential social and economic impacts include the following:

- Loss of employment for Project operations staff.
- Loss of goods or service contracts for local suppliers or contractors.
- Potential loss of residents from nearby communities associated with changing workforce and contract supply if alternate suitable employment is not present within the region.

- Local economic downturn as spending decreases associated with changing workforce if people left the area and related Project contracts.
- Reduced options for export of product from the region, as Port Lincoln has shown a preference for limited export through this facility and other shipping options can pose commercial transport challenges.
- Potential future benefit in the wharf being used as a fishing or tourism facility.
- Electricity supply gain to the region from the electrical retailer due to reduced load from Project., and
- Total water supply volume gain from SA Water to the region associated with cessation of Project water allocation.

7.0 RISK ASSESSMENT AND MITIGATION

This chapter outlines key elements of the environmental management framework, mitigation and monitoring measures proposed for the Project. It was prepared to communicate Centrex's commitment to environmental management and responsible corporate citizenship. Centrex is committed to undertaking activities in an environmental responsible manner in compliance with their corporate Environment Policy, September 2006.

This chapter includes the following information:

- Environmental management framework (refer Section 7.1).
- Qualitative impact risk and residual impact risk assessment (refer Section 7.2).
- Proposed environmental objectives and monitoring program and environmental and social mitigation measures, (refer section 7.3), based on the impact assessment provided in Section 6., and
- Conclusions and summary (refer Section 7.4).

7.1 Environmental Management Framework

It is noted that Centrex does not plan to operate the Port, rather, a suitably experienced commercial port operator would be appointed at a future date. The following provides an overall framework for environmental management content requirements for the construction and operation phases of the Project:

- Management commitment
- Personnel roles and responsibilities for environmental and social management activities
- Personnel and contractor induction and training procedures and processes
- Compliance monitoring and auditing procedures and processes including continual improvement assessment and feedback processes
- Environmental monitoring plans
- Environmental licensing, legislative and compliance requirements.
- Emergency and incident management and response plans and processes. In addition these will be consulted on with relevant State and local agencies
- Environmental performance criteria and objectives
- Environmental procedures for activities and tasks, and
- Development and implementation of ISO14001:2004 compliant Environmental Management System for operations

The following Environmental Management Plans are outlined in this PER as a requirement of future construction and operation phases:

- Construction Environmental Management and Monitoring Plan (CEMMP):
 - Air Quality Management Plan
 - Waste Management Plan
 - Revegetation and Rehabilitation Plan
 - Weed and Pest Management Plan
 - Construction Soil Erosion and Drainage Management Plan (SEDMP)
 - Energy Efficiency Plan
 - Maritime Water Quality Management Plan including monitoring program
- Operational Environmental Management and Monitoring Plan (OEMMP):
 - Air Quality Management Plan
 - Waste Management Plan
 - Revegetation and Rehabilitation Plan
 - Weed and Pest Management Plan
 - Energy Efficiency Plan
 - Maritime Pest Management Plan
 - Site Water Management Plan
 - Maritime Water Quality Management Plan including monitoring program, and
- Emergency Response and Incident Management Plan, including maritime and terrestrial response processes and procedures.

7.2 Qualitative Risk Assessment Framework

A qualitative risk assessment was undertaken to assess the potential environmental and socio-economic impacts associated with construction, operation and decommissioning of the Port, as applicable. The likelihood and consequence of each impact was ranked in accordance with Table 7-1 and Table 7-3, respectively. A risk ranking was then assigned based on the likelihood and consequence rankings, in accordance with Table 7-2.

The following definitions are provided of key risk assessment terms:

- Consequence: the outcome or severity of an impact/event occurring
- Likelihood: the estimated probability or frequency of occurrences or an event occurring over time, and
- Risk: is a combination of the likelihood of an event occurring and the severity or outcome of the consequence of the event.

A residual risk assessment was assigned after consideration of key mitigation measures and the impacts outlined in Section 6. A summary of this is presented in Table 7-4. Detailed mitigation and monitoring measures identified through the impact assessment process are provided in Section 7.3.

Table 7-1: Description of Likelihood

Description	Likelihood Criteria (read as either/or)
Almost Certain	<ul style="list-style-type: none"> ■ The event will occur ■ The event is of a continuous nature ■ The likelihood is unknown
Likely	<ul style="list-style-type: none"> ■ Will probably occur during operation lifetime
Possible	<ul style="list-style-type: none"> ■ Could occur in most operations
Unlikely	<ul style="list-style-type: none"> ■ Could occur in some operations but is not expected to occur
Rare	<ul style="list-style-type: none"> ■ Has almost never occurred in similar operations but conceivably could

Table 7-2: Qualitative Risk Matrix

			Likelihood of Consequence				
			E	D	C	B	A
			Rare	Unlikely	Possible	Likely	Almost Certain
Severity of Consequence	5	Insignificant	Low 5E	Low 5D	Low 5C	Moderate 5B	Moderate 5A
	4	Minor	Low 4E	Low 4D	Moderate 4C	High 4B	High 4A
	3	Moderate	Moderate 3E	Moderate 3D	High 3C	High 3B	Extreme 3A
	2	Major	High 2E	High 2D	Extreme 2C	Extreme 2B	Extreme 2A
	1	Catastrophic	High 1E	Extreme 1D	Extreme 1C	Extreme 1B	Extreme 1A

Table 7-3: Description of Consequence

Description	Consequence Criteria (read as either/or)		
	Social	Environmental	Economic and legal
Insignificant	<ul style="list-style-type: none"> Not of concern to the wider community No inquiries or complaints 	<ul style="list-style-type: none"> Possible impacts within the proposed Project site boundaries and immediate marine environment but without noticeable consequence No impacts of consequence at local, regional or State level. 	<ul style="list-style-type: none"> No costs or limited cost for rehabilitation or mitigation No breach of regulator standards or licences
Minor	<ul style="list-style-type: none"> Not of significant concern to local or wider community Isolated inquiries or complaints 	<ul style="list-style-type: none"> Some reversible impact within the proposed Project site boundaries and immediate marine environment with no significant long-term changes May be rehabilitated or alleviated without outside assistance 	<ul style="list-style-type: none"> Cost for any rehabilitation is minor No breach of regulator standards or licences
Moderate	<ul style="list-style-type: none"> General local concern Multiple inquiries and/or complaints 	<ul style="list-style-type: none"> Significant changes within the proposed Project site boundaries or marine environment with potential for long term change and remediation required Minor changes outside proposed Project site boundaries that may be simply rehabilitated or alleviated with outside assistance 	<ul style="list-style-type: none"> Possible breach of legal obligations – inquiries and/or instruction from regulatory authorities
Major	<ul style="list-style-type: none"> Will attract significant public concern Widespread complaints and/or lobbying by representative groups 	<ul style="list-style-type: none"> Substantial and significant changes within and/or outside the proposed Project site boundaries that can only be partially rehabilitated or alleviated Long-term consequences 	<ul style="list-style-type: none"> Major costs associated with rehabilitation/alleviation Serious breach of legal obligations – regular inquiries by regulatory authorities and penalties for non-compliance
Catastrophic	<ul style="list-style-type: none"> Major public outrage Deaths or widespread health and economic effects on public 	<ul style="list-style-type: none"> Extreme permanent changes to social or natural environment that cannot be practically or significantly rehabilitated or alleviated 	<ul style="list-style-type: none"> Major costs associated with rehabilitation / alleviation and penalties Major breach of legal obligations – continual involvement of regulatory authorities and legal investigation for non-compliance

Table 7-4: Qualitative Project Risk Assessment

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
1.	Air Emissions – dust and fugitive emissions	<ul style="list-style-type: none"> ■ The closest sensitive receptor is around 500 m from the project site. ■ There is potential for dust associated with ground clearing and construction activities. The Project site is generally clear with minor vegetation cover. ■ There is potential for dust from loading and unloading of grain, hematite and future export products. ■ Eyre Peninsula can experience high wind and existing dust movement events. 	High (Almost Certain x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.2. ■ Conveyor belts will be fully enclosed. ■ All unloading activities will occur in enclosed buildings. ■ Storage sheds will include ventilation systems, dust collectors and air filters to reduce potential dust emissions. ■ Based on air dispersion modelling of PM₁₀ and PM_{2.5} and worst case scenarios maximum predicted criteria are expected to comply with Ambient Air Quality National Environment Protection Measure criteria (1988 and 2003) at sensitive receptors (refer Section 6.5). ■ An Air Quality Management Plan will be developed for construction phase including clearing, rehabilitation and wind protection measures. ■ Ship loading will include dust controls to minimise emissions. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
2.	Greenhouse Gas (GHG) Emissions	<ul style="list-style-type: none"> ■ Construction phase GHG will arise from earth moving equipment, offshore jetty construction equipment, generator, transport vehicles and light vehicles. ■ Operations phase GHG will arise from power use onsite associated with site loading and storage facilities and offices as well as transport of good to the Project. ■ Due to the power and fuel requirements for the Port it is inevitable that GHG will be produced as part of normal development. 	Moderate (Almost Certain x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.3. ■ Energy efficiency measures will be assessed and implemented during construction and operations phase. ■ Where practicable, local and recycled materials will be used. ■ Overall the Port offers the potential to significantly reduce GHG emissions associated with ore transport to other port options, (refer Section 6.1), while it is recognised the Ports establishment will create GHG. ■ Fuel and power use will be monitored during construction and operation. ■ Future potential for the Port to join the proposed Eyre Peninsula 'green power' grid. This will continue to be investigated. 	Moderate (Almost Certain x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
3.	Noise	<ul style="list-style-type: none"> ■ Noise from vehicle, equipment and loading/unloading operations has potential to disturb residents, fauna and visitors. ■ The nearest sensitive receptor to the Project site is approximately 500 m north of the Project boundary. The Project is located about 1,000 m from the majority of noise sensitive locations. The nearest residence to Lipson Cove Road is 200 m. The Lipson Island Conservation Park informal camping area is 1.5 km from the Project site. ■ Based on current zoning the noise levels for the project are 47 dB(A) during daytime and 40 dB(A) during night time activities. 	Extreme (Almost Certain x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.4. ■ Noise modelling estimates indicate residences along Lipson Cove Road will not exceed noise criteria from road traffic. ■ Conveyor belts will be fully enclosed. ■ All unloading activities will occur in enclosed buildings. ■ Mobile equipment will use broad band reverse alarms and are expected to meet night time noise criterion. ■ Cetacean monitoring will be undertaken during marine piling to minimise impacts to marine mammals in close proximity to the Project area. ■ A noise and vibration monitoring regime will be developed for construction to confirm expected levels. ■ Generators will be located in such a way as to minimise offsite noise movement. 	Low (Unlikely x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
4.	Stormwater / Surface water	<ul style="list-style-type: none"> ■ Surface water flows in and around the Project area are limited to rainfall based events. ■ Stormwater from the Port hardstand and works areas has potential to leave the site and enter the marine environment. SA EPA require stormwater from such a facility to be managed onsite and avoid discharge to the marine environment. ■ There is potential for stormwater contamination from onsite chemical and fuel storage areas. 	Extreme (Almost Certain x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.5. ■ No stormwater discharge from the site to the ocean. ■ Stormwater detention basins and channels will capture and retain stormwater onsite and minimise offsite surface water flow onto the Project area. ■ All chemicals and fuels will be stored in appropriate bunded facilities. ■ Captured stormwater will be reused onsite. ■ Operations include water sensitive urban design principles. ■ Surface water and stormwater basins and channels will be maintained to prevent sediment build up. 	Low (Unlikely x Minor)
5.	Groundwater	<ul style="list-style-type: none"> ■ Groundwater levels at the Project site range from 0.9 m above AHD and 2.3 m. ■ The Project does not plan to use any groundwater resources. ■ Project activities including chemical and fuel use have potential to impact groundwater resources. Onsite hydrocarbon storage facilities are proposed with a 68,000 L capacity. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.6. ■ All chemicals and fuels will be stored in appropriately bunded areas. ■ Appropriate spill kits will be maintained onsite during construction and operations phase. ■ Refer item 4.0 Surface water and Stormwater. ■ Any onsite domestic wastewater management to comply with local planning requirements. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
6.	Terrestrial Flora	<ul style="list-style-type: none"> ■ The Project site is highly modified and dominated by pasture flora species with no significant trees or threatened species identified. ■ All native vegetation within the Project area is disturbed or degraded. With the exceptions of the Low Shrubland along the cliff top and the Tall Open Shrubland associated with Rogers Beach, vegetation is considered to be of low habitat and biodiversity value. ■ No threatened or rare species occur in the Project area. ■ Vegetation clearance is required as part of Port construction as well as Swaffers Road upgrade. ■ Approximately 7.88 ha of low grade native vegetation is required for site clearing to enable construction, out of a total of 48 ha of land required for Stage 1. The total site footprint is 140 ha. A further 7.78 ha of degraded scattered native vegetation is required to be cleared in the widening of Swaffers Road. A total of 15.66 ha of native vegetation is required to be offset through the establishment of a SEB. 	Moderate (Almost Certain x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.7. ■ A Construction Environmental Management and Monitoring Plan will be developed. ■ Only those areas required for the Project will be cleared. Vegetation to be cleared along Swaffers Road and the Tall Open Shrubland within the clay pan are highly degraded and of low habitat/biodiversity value. ■ Rogers Beach is not part of the Project area. ■ Significant Environmental Benefits (SEB) are proposed to offset vegetation clearance. ■ A site Rehabilitation and Revegetation Plan will be developed including native species for replanting. 	Low (Possible x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
7.	Terrestrial Fauna	<ul style="list-style-type: none"> ■ The Project site is highly modified and dominated by pasture flora species with no significant trees or threatened species located. The habitat and biodiversity value of remaining native vegetation is low and disturbed, with the exception of the Low Shrubland located along the coastal cliff top, that is of regional significance, and supports several species of lizard. ■ There were no native fauna species of state or national significance identified during Spring survey or expected to depend on the site. ■ There is potential to disturb or impact fauna through construction and operation activities associated with light, noise and vehicle movement. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.7. ■ Refer Item 6, Terrestrial Flora. ■ Vehicle movement to remain on designated road access areas only. ■ Any trenches or holes to be left uncovered will be inspected daily for trapped fauna. Any trapped fauna to be released into nearby habitat. ■ The creation of a SEB habitat would increase the habitat available to local and regional fauna. 	Low (Possible x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
8.	Terrestrial Weeds, Pests and Pathogens	<ul style="list-style-type: none"> ■ All native vegetation within the Project area is disturbed or degraded with weeds and invasive species making up 33% of species composition. ■ There are pest fauna species present including rabbits, foxes and other feral species. ■ There is potential for spread of weeds associated with construction activities or introduction with equipment entering the site. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.7. ■ All plant equipment and machinery entering and leaving the site should be clean and pest/soil/weed free. ■ All waste will be managed in accordance with site environmental management procedures and disposed of accordingly. ■ A Weed and Pest Management Plan will be developed and implemented for construction and operations in compliance with the requirements of the <i>Natural Resources Management Act 2004</i>. 	Low (Possible x Insignificant)
9.	Lipson Island Terrestrial Fauna	<ul style="list-style-type: none"> ■ Lipson Island is located approximately 1.5 km south of the jetty and is located in the State Lipson Cove Conservation Park. ■ Lipson Island supports populations of breeding birds including the Little Penguin (not a listed species), Fairy Terns (listed as vulnerable), and migratory waders. ■ There is potential for noise and light from Port operations to disturb fauna species. 	High (Possible x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.8. ■ Based on ecology and noise studies it is not expected that noise (predicted at less than 33 dB(A)) or light from the operations or construction of the Port will negatively impact breeding or habitation of fauna species on Lipson Island. ■ Lights at the Port will be domed focussed low level lights and will minimise potential light pollution. ■ Measure and monitor potential light impacts at Lipson Cove to demonstrate mitigation is effective. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
10.	Lipson Island Terrestrial Flora	<ul style="list-style-type: none"> ■ Refer Item 9, Lipson Island Terrestrial Fauna. ■ There is no significant native flora present on Lipson Island. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> ■ There are no specific management measures proposed. Lipson Island is located within a State park administered by Parks SA and does not form part of Centrex's Project area. There are no negative Project impacts expected to native flora at the site. 	Low (Rare x Insignificant)
11.	Lipson Island Marine Fauna and Flora	<ul style="list-style-type: none"> ■ Refer Item 9, Lipson Island Terrestrial Fauna. ■ Surveys undertaken at Lipson Island did not identify inter-tidal marine species of conservation significance or marine flora species. ■ There is potential for impacts in the unlikely event of an oil or fuel spill, waste leaving site. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.8 and Item 22. ■ A Waste Management Plan will be developed to ensure all waste types produced by the Project are managed appropriately and do not contribute to marine waste in surrounding areas. ■ Pile fabric filtering will be used around each pile during construction to minimise the potential for turbidity associated with the Project. ■ Port operations will include emergency procedures and protocols in the unlikely event of a marine oil or fuel spill. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
12.	Soils	<ul style="list-style-type: none"> ■ The Project is located on a rocky headland and some blasting will likely be required as part of construction civil works. Soils are predominantly sodic with high erosive potential. ■ There is potential for soil contamination associated with chemical, fuel and waste management onsite or spillage of ore onto exposed ground. ■ There is potential for wind and water erosion in cleared areas of site. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.9. ■ Only those areas required for Port operations and construction will be cleared. ■ Vehicle movement will be limited to designated access tracks only. ■ Exposed areas will be rehabilitated where suitable. ■ Dust suppression watering will be undertaken during clearing and construction activities. ■ All hematite unloading activities will occur in enclosed buildings. ■ All chemicals and fuels to be stored in appropriately banded areas. ■ A Waste Management Plan will be developed in accordance with reduce, reuse and recycle principles. ■ Appropriate spill kits will be maintained onsite during construction and operations phase. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
13.	Marine Flora (jetty)	<ul style="list-style-type: none"> ■ Marine surveys have identified that macroalgal dominated rocky reefs and seagrass meadows are the most common native vegetation type within the proposed jetty area. These are representative of those found further afield in the region. ■ It is estimated rocky reef habitat and seagrass may have some level of disturbance due to the Project, and be limited to that area under and around the jetty. ■ The potential displacement of marine fauna associated with seagrass loss is expected to be small compared to extent of seagrass and macroalgal assemblages in the region. ■ The jetty is proposed to be 515 m long, 55 m wide with a 345 m berthing jetty at 90° to the main jetty. It is estimated 64 jetty piles and 120 berthing jetty piles would be required, subject to actual final design needs. ■ Potential impacts due to jetty shading, turbidity or sedimentation. ■ No significant inter-tidal, shell fish bed, marine mammal haul out sites or seabed habitats identified. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.10. ■ End over end jetty construction method will minimise marine impacts. ■ A Construction Environmental Management and Monitoring Plan will be developed. ■ Pile fabric filtering will be used around each pile during construction to minimise the potential for turbidity associated with the Project. ■ A marine Emergency Response and Incident Management Plan will be developed. ■ Conveyor belts will be fully enclosed. 	Moderate (Possible x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
14.	Marine Fauna (jetty)	<ul style="list-style-type: none"> ■ There were no threatened or endangered marine species identified during marine survey. ■ There were some recreational and commercially significant fish species identified in the rocky reef and seagrass areas. ■ The Project site does not offer significant habitat to marine mammals or cetaceans. ■ There were Greenlip and Blacklip abalone found in reef surveys and fringing seagrass areas around the Project area. ■ Marine fauna may be impacted by changes to marine flora as well as noise, turbidity or sedimentation impacts, fishing from visiting vessel crews. 	High (Likely x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.10. ■ Refer Item 13, Marine Flora (jetty) and Item 15, Marine Pests. ■ Visiting ship crews will not be permitted to leave vessels while berthed at Port Spencer. Site security protocols will be implemented to prevent illegal fishing or leaving of vessels. ■ Fishing by Port personnel or third parties will not be permitted from the Port site. ■ During piling operations visual spotters will monitor the ocean to ensure marine mammals and cetaceans are not present within 500 m of the activities. 	Moderate (Possible x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
15.	Marine Pests	<ul style="list-style-type: none"> ■ There is potential for introduction of marine pests associated with ballast water and hull fouling of visiting ships. ■ Marine surveys identified the presence of marine pest, Asian Date Mussel. 	High (Possible x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.10. ■ All vessels to comply with <i>Australian Ballast Water Management Requirements, 2001</i> and the <i>Australian Quarantine Regulations 2000</i>. ■ A Management and Monitoring program will be developed to identify potential marine pest species and appropriate management measures. ■ A control and monitoring program for the present Asian Date Mussel will be developed for the Port. 	High (Possible x Moderate)
16.	Coastal Processes	<ul style="list-style-type: none"> ■ There is potential for jetty construction to impact movement of sediment and lead to scouring around the Project area and therefore impact beaches and other coastal processes. ■ Rogers Beach is located adjacent the north of the Project site. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Based on hydrodynamic modelling only localised sediment and scouring effects around the jetty are expected. ■ Significant impacts to beaches around the Project are not expected, including Rogers Beach and Lipson Island. ■ A Construction Environmental Management and Monitoring Plan will be developed. ■ Pile fabric filtering will be used around each pile during construction to minimise the potential for turbidity associated with the Project. 	Low (Possible x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
17.	Traffic	<ul style="list-style-type: none"> ■ The main traffic movements to and from the Project will be road transport of hematite and grain and construction traffic over a 24 month period. ■ Transport from Wilgerup Mine to the Port (Swaffers Road) is not considered as part of this PER. ■ Heavy vehicle access will be via currently unsealed Swaffers Road and light vehicle via the currently unsealed Lipson Cove Road. ■ Increased traffic poses potential safety, amenity, and noise impacts. 	Extreme (Almost Certain x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.11. ■ Lipson Cove Road would be sealed and upgraded, and used for light vehicles only. ■ Swaffers Road would be widened and sealed to cater for expected heavy vehicle traffic. ■ The intersection of Swaffers Road and Lincoln Highway will consider a right turn facility and final design will be undertaken in conjunction with DPTI. ■ Upgrade of traffic warning signs at the intersection of Coast and Swaffers Road and vegetation pruning to increase sight distances. ■ Discussion will be held with Council regarding the potential sealing of at least 130 m of Coast Road to the south and 180 m to the north to minimise the potential for gravel drag out and safety risks to Swaffers Road. ■ All Project vehicles will comply with State and Project speed restrictions and vehicle access limits. 	Moderate (Possible x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
18.	European Heritage	<ul style="list-style-type: none"> ■ Archaeology survey of the Project site and Swaffers Road did not identify any European heritage sites of significance as listed under the South Australian Heritage Register, or recognised by DENR or Tumby Bay Council. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.12. 	Low (Rare x Insignificant)
19.	Maritime Heritage	<ul style="list-style-type: none"> ■ The <i>Three Sisters</i> maritime wreck is located approximately 1.5 km south of the jetty in the Lipson Island Conservation Park. This was identified during Project archaeology surveys. ■ There are no listed maritime heritage sites within close proximity or expected shipping lanes to the Port. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.12. 	Low (Rare x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
20.	Indigenous Heritage	<ul style="list-style-type: none"> ■ No sites, as defined under the <i>Aboriginal Heritage Act 1988</i>, were listed on the SA Register of Sites and Objects or <i>Commonwealth Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> within the Project area. ■ The Rogers Beach dunes are likely to have unregistered Indigenous heritage items, however this is outside the Project area. ■ Although there are no archaeological or anthropological sites of significance expected within the Project area there is potential for artifacts to exist and disturbance through construction excavation. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.12. ■ Cultural heritage management procedures will be developed as part of the construction phase. These will include protocols in the case of disturbance and notification of appropriate government agencies. ■ A site walkover with Indigenous heritage monitors will be undertaken prior to construction starting. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
21.	Visual Amenity	<ul style="list-style-type: none"> ■ The Project is located along remote coastline on the Eyre Peninsula and will alter the current coastal view. ■ The site is located in gently undulating coastal areas. Rogers Beach located adjacent the north of the site is accessible with unsealed track through existing farmer properties. ■ Lipson Island Conservation Park is located 1.5 km south from the Project jetty and includes a small informal camping area. ■ The nearest sensitive receptor is inland approximately 1 km. 	High (Almost Certain x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.13. ■ Decommissioning phase should the Project proceed is likely to be decades into the future. At this stage removal of unnecessary land based infrastructure would be reviewed. ■ Planting of screening vegetation between 2-4 m height on Lipson Cove Road along southern Project boundaries. ■ Lights at the Port will be domed focussed low level lights and will minimise visibility. ■ Port facilities will be coloured in earthen tones to reduce visibility. ■ Infrastructure to be built behind the headland. 	Low (Possible x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
22.	Waste	<ul style="list-style-type: none"> ■ There is potential to generate minor volumes of chemical, domestic, septic, packing and office wastes. ■ The draft SA Waste Strategy 2010-2015 outlines the preferred waste management hierarchy. ■ Waste poses a number of potential hazards including attraction of pests, contamination of soil and water resources, and negative impacts to marine flora and fauna. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.14. ■ A Waste Management Plan will be developed in accordance with reduce, reuse and recycle principles for construction and operation phases and appropriate tracking systems. ■ All waste will be disposed of in accordance with EPA requirements. ■ An approved domestic septic system will be installed and suitably maintained. ■ Refer Item 4, Stormwater / Surface water. 	Low (Possible x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
23.	Chemical Storage and Handling	<ul style="list-style-type: none"> ■ The Project will include a 68,000 L fuel oil storage facility and a 10,000 L fuel storage facility. ■ Other minor chemical volumes will be stored onsite for general operational uses. ■ There is potential for chemicals to contaminate surface, ground and marine water, soil and ecology resources through spills or leaks. 	High (Possible x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.14. ■ A Waste Management Plan will be developed in accordance with reduce, reuse and recycle principles for construction and operation phases and appropriate tracking systems. ■ Fuel and chemical tracking systems to be implemented onsite. ■ All waste will be disposed of in accordance with EPA requirements. ■ Stormwater detention basins and channels will capture and retain stormwater onsite and minimise offsite surface water flow onto the Project area. ■ All chemicals and fuels will be stored in appropriate bunded facilities. ■ Fuel oil and fuel storage facilities will comply with the requirements of AS1940:2004, <i>The storage and handling of flammable and combustible liquids</i>. ■ Appropriate spill kits will be maintained onsite during construction and operations phase. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
24.	Maritime Spills, Leaks and Anti-foulants (Port area)	<ul style="list-style-type: none"> ■ There is potential for vessel spills or leaks as well as anti-foulants to pose a contamination risk to the Port area. Contamination could impact marine fauna and flora, as well as sediment and water quality in and around the area. ■ Significant spills while at berth are uncommon in general port operation. ■ The Port will be used for export only and maritime import of fuel or chemicals is not planned as part of the operations under this PER. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Development of a marine Emergency Response and Incident Management Plan will be undertaken. ■ Refer Item 23, Chemical Storage and Handling. ■ Conveyor belts will be fully enclosed. ■ A marine water monitoring program will be developed as part of operations and construction to monitor water quality. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
25.	Spencer Gulf: Maritime Spills	<ul style="list-style-type: none"> ■ There is potential for vessel spills to pose a contamination risk to the Spencer Gulf. This would be predominantly associated with a shipping accident (damage to vessel) or poorly maintained vessel. Contamination could impact marine fauna and flora, as well as sediment and water quality in and around the area. ■ Significant spills in deep water, away from reefs and coastal area are uncommon in the Spencer Gulf. Vessels will not be travelling within marine parks or reef areas. ■ The Port will be used for export only and maritime import of fuel or hazardous chemicals is not planned as part of the operations under this PER. ■ There will not be fuel or transfer of waste/materials loading or unloading undertaken by vessels within the Gulf. 	Moderate (Unlikely x Moderate)	<ul style="list-style-type: none"> ■ A detailed hydrographic study would be undertaken prior to operations to establish a clear shipping lane from the Port to Spencer Gulf deep water. Appropriate navigation aids will be installed. ■ Emergency response procedures for spills in the marine environment would adhere to the requirements specified in Australia's National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances (AMSA, 2007). 	Low (Rare x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
26.	Spencer Gulf: Marine Mammal Collision	<ul style="list-style-type: none"> ■ There is potential for marine mammal collision with a ship or propeller during shipping movements to and from the Port within the Spencer Gulf. ■ The Port area or Spencer Gulf deep water is not significant habitat for breeding purposes, where more protected waters are preferred. ■ There is potential for mammal movement within the area, including whales, dolphins or seals. Shipping numbers will add to existing shipping traffic in the gulf. 	Moderate (Unlikely x Moderate)	<ul style="list-style-type: none"> ■ Refer Item 25. ■ Shipping traffic would not travel through marine park areas (Sir Joseph Banks or Lipson Island) and remain within deepwater gulf channels. 	Low (Unlikely x Minor)
27.	Vessel Anchored Stability	<ul style="list-style-type: none"> ■ An anchoring study was undertaken to assess the potential for vessel movement should an anchor not hold in varying weather conditions. The study demonstrated anchors would have a low risk of not securing Cape class vessels (PB, 2011). ■ In strong weather conditions shipping vessels will be parked 4 km offshore. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> ■ A detailed hydrographic study would be undertaken prior to operations to establish a clear shipping lane from the Port to Spencer Gulf deep water and would undertake opportunistic offshore sediment sampling to confirm sea bed conditions for anchoring. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
28.	Local and Regional Economics	<ul style="list-style-type: none"> ■ There are limited expected negative economic impacts. There is potential for the Port to offer local and regional employment and supply contract opportunities. ■ The Project workforce may pose short term supply and price pressure to local rental accommodation options, particularly during construction phase. ■ The Port site is located on a relatively small area of land and unlikely to cause significant negative impacts to agricultural production in the area. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.15. ■ Project workers will potentially be accommodated in a purpose built Centrex Tumby Bay accommodation facility to reduce pressure on local housing. ■ Positions will be open to local and regional applicants with suitable skills. ■ Contract and supply options will be open to local and regional businesses including for the accommodation facility. 	Low (Unlikely x Insignificant)
29.	Local and Regional Infrastructure	<ul style="list-style-type: none"> ■ There is potential for the Project's water and power demands to add to regional infrastructure supply burden and government expenditure costs. ■ Centrex would pay the capital costs required to extend a spur line from the existing ElectraNet power transmission line and SA water main water pipeline to the site. ■ The Port is a privately funded development. Centrex would fund local Swaffers and Lipson Cove road upgrades. 	Low (Unlikely x Insignificant)	<ul style="list-style-type: none"> ■ Refer Section 7.3.15. 	Low (Unlikely x Insignificant)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
30.	Local and Regional Services	<ul style="list-style-type: none"> ■ The Project may contribute to an increased demand on health and emergency services associated with workforce numbers and industrial activities. ■ There are existing health and emergency services in the region and local townships, including Tumby Bay Hospital. ■ The construction workforce will be significantly higher than operations. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> ■ Refer Section 7.3.15. ■ Centrex will link and plan with local emergency and health services to keep them informed of Project development, demand and risks. ■ Emergency response plans will be developed and implemented for the site during construction, operations and decommissioning phases. ■ First aid services will be provided onsite for minor ailments and injuries. 	Low (Unlikely x Minor)
31.	Social amenity	<ul style="list-style-type: none"> ■ There is potential for social disruption associated with fly in fly out construction/operations workforce from antisocial behaviour, disruption to usual local sense of amenity etc. ■ Construction phase will have over 200 employment positions and up to 70 for operations. Many may be fly in / fly out workers to ensure appropriate skills and experience. 	High (Possible x Moderate)	<ul style="list-style-type: none"> ■ Refer Section 7.3.15. ■ A Code of Conduct, including a shift zero tolerance of alcohol policy, for all Project personnel will be implemented. ■ Refer Item 25, Local and Regional Economics. ■ Project workers will be potentially accommodated in purpose built accommodation including meals and transport to reduce pressure on local housing, roads and community. ■ The impact from construction to operations phase will reduce significantly with the smaller workforce. 	Low (Unlikely x Minor)

No.	Project Aspect	Comment / Port Spencer Detail	Risk (Likelihood x Consequence)	Management Measures	Residual Risk (Likelihood x Consequence)
32.	Tourism and Recreation Values	<ul style="list-style-type: none"> ■ The Project is located in a remote area of the coastline on private land. ■ Tourism provides contribution to local and regional economy. ■ The Port may provide a point of tourist interest. ■ A private beach (Rogers Beach) abuts the northern aspect of the site. Access to the beach will be maintained by Centrex. ■ Lipson Cove has a small informal camping area approximately 1.6 km south of the proposed jetty. Significant negative noise or light impacts are not expected at this site. ■ There are no major built tourism areas or sites within close proximity to the site, 	Low (Unlikely x Insignificant)	<ul style="list-style-type: none"> ■ Refer Item 21, Visual Amenity. ■ Refer Section 7.3.15. ■ Project design includes consideration of visual screening aspects including vegetative screening, built infrastructure colour, and use of existing topography to screen the site. 	Low (Unlikely x Insignificant)

7.3 Mitigation and Monitoring Measures

This section provides a description of the mitigation and monitoring measures Centrex will implement to eliminate, reduce or minimise the potential impacts of the Project to the extent practical. It also summarises the key performance objectives for management and monitoring actions suggested for the Port.

As part of overall Project management appropriate training and induction materials and processes would be developed and implemented for all personnel, contractors or third parties entering the site. This is a key part of ensuring successful implementation of all management and monitoring responsibilities at the site.

7.3.1 Environmental Monitoring and Objectives

Table 7-5 provides a summary of environmental management objectives, residual risk and monitoring measures. Monitoring measures are based on either moderate and high residual risks or the need for ongoing surveillance to assure achievement of environment objectives and/or modelling results undertaken as part of the impact assessment. Environmental management objectives describe the aims for management outcomes relating to the environmental aspect.

Table 7-5: Environmental Management Objectives, and Monitoring

No.	Environmental Aspect	Environmental Management Objective	Residual Risk After Management Measures	Monitoring Measure
1.	Air Emissions – dust and fugitive emissions	<ul style="list-style-type: none"> ■ To ensure no significant negative impacts to amenity. ■ To prevent negative impacts to ambient air quality at sensitive receptors. ■ To minimise dust associated with loading and unloading of hematite and grain. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> ■ A PM₁₀ and PM_{2.5} monitoring program will be developed as part of the site Air Quality Monitoring Program.
2.	Greenhouse Gas (GHG) Emissions	<ul style="list-style-type: none"> ■ To minimise the potential for greenhouse emissions. 	Moderate (Almost Certain x Insignificant)	<ul style="list-style-type: none"> ■ The Project will monitor GHG emissions during construction and operation phase.
3.	Noise	<ul style="list-style-type: none"> ■ To comply with noise criteria for Port operation at sensitive receptors. 	Low (Unlikely x Insignificant)	<ul style="list-style-type: none"> ■ A noise and vibration monitoring regime will be developed for construction to confirm expected levels.
4.	Stormwater / Surface Water	<ul style="list-style-type: none"> ■ No offsite discharge of stormwater to the marine environment. ■ To capture and reuse onsite stormwater. ■ To minimise potential for chemical contamination of stormwater. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> ■ In the case of spill or incident management surface water and stormwater monitoring may be undertaken as appropriate.

No.	Environmental Aspect	Environmental Management Objective	Residual Risk After Management Measures	Monitoring Measure
5.	Groundwater	<ul style="list-style-type: none"> To prevent contamination of groundwater resources. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> Groundwater monitoring is not proposed as part of this PER. In the case of spill or incident management groundwater monitoring may be undertaken as appropriate.
6.	Terrestrial Flora	<ul style="list-style-type: none"> To minimise vegetation clearing. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
7.	Terrestrial Fauna	<ul style="list-style-type: none"> To prevent injury or death to terrestrial fauna arising from construction or operations. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
8.	Weeds, Pests and Pathogens	<ul style="list-style-type: none"> To reduce the potential for spread of weeds, pests or pathogens. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> As part of development of a site Weed and Pest Management Plan a monitoring program will be developed.
9.	Lipson Island Terrestrial Fauna	<ul style="list-style-type: none"> To prevent disturbance of birds on Lipson Island. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
10.	Lipson Island Terrestrial Flora	<ul style="list-style-type: none"> There was no native flora present on Lipson Island. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
11.	Lipson Island Marine Fauna and Flora	<ul style="list-style-type: none"> To prevent disturbance of existing marine resources. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> Monitoring of light impacts during operation at Lipson Island to validate expected impacts.
12.	Soils	<ul style="list-style-type: none"> To prevent soil contamination. To minimise potential for soil erosion. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER. In the case of spill or incident management soil monitoring may be undertaken as appropriate.
13.	Marine Flora (jetty)	<ul style="list-style-type: none"> To minimise the area of impact. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> Monitoring of expected impacts to seagrass and marine flora will be undertaken.
14.	Marine Fauna	<ul style="list-style-type: none"> To minimise the extent and potential for negative impacts to marine habitats. To prevent contamination of the marine environment. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.

No.	Environmental Aspect	Environmental Management Objective	Residual Risk After Management Measures	Monitoring Measure
15.	Marine Pests	<ul style="list-style-type: none"> To prevent introducing marine pests from shipping activities. To control existing marine pest species. To prevent transport of existing marine pest species to other ports. 	High (Possible x Moderate)	<ul style="list-style-type: none"> A marine pest monitoring program will be designed for construction and operations phase.
16.	Coastal Processes	<ul style="list-style-type: none"> To minimise sedimentation of the sea bed and marine flora. To protect beaches north and south of the Port. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> A Project area sediment monitoring program will be developed to validate the quantity of sediment deposition in and around the jetty in line with predicted impacts.
17.	Traffic	<ul style="list-style-type: none"> To restrict Project traffic to approved transport corridors. 	Moderate (Possible x Minor)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
18.	European Heritage	<ul style="list-style-type: none"> To avoid disturbance or damage of registered heritage sites. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
19.	Maritime Heritage	<ul style="list-style-type: none"> To avoid disturbance or damage of registered heritage sites. 	Low (Rare x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
20.	Indigenous Heritage	<ul style="list-style-type: none"> To comply with the <i>Aboriginal Heritage Act 1988</i> requirements for artefact or heritage item disturbance and approval. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> Indigenous heritage monitors will be employed as part of pre-construction site clearance activities.
21.	Visual Amenity	<ul style="list-style-type: none"> To reduce the visibility of the Project as much as practicable. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
22.	Waste	<ul style="list-style-type: none"> To comply with State Waste Strategy and undertake waste management in accordance with the principles of reduce, reuse and recycle. To minimise the potential for attraction of pests and vermin. To prevent contamination of soil or water resources. 	Low (Possible x Insignificant)	<ul style="list-style-type: none"> No monitoring is proposed as part of this PER.
23.	Chemical Storage and Handling	<ul style="list-style-type: none"> To prevent soil, surface water, groundwater or maritime water contamination. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> Monitoring of chemical and hydrocarbon stores and volume reconciliation will be undertaken as part of Port operations. Refer Item 24.

No.	Environmental Aspect	Environmental Management Objective	Residual Risk After Management Measures	Monitoring Measure
24.	Maritime Spills, Leaks and Anti-foulants	<ul style="list-style-type: none"> To avoid potential marine water contamination. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> A marine water quality monitoring program will be designed for construction and operation phases.
25.	Spencer Gulf: Maritime Spills	<ul style="list-style-type: none"> To avoid potential for maritime contamination. 	Low (Rare x Minor)	<ul style="list-style-type: none"> Prior to operations a hydrographic study of the seabed will be undertaken to ensure suitable obstruction free shipping lane from jetty to main Spencer Gulf shipping lanes. Navigation aids and emergency response plans will be reviewed and established prior to operations.
26.	Spencer Gulf: Marine Mammal Collision	<ul style="list-style-type: none"> To reduce potential for marine mammal collision with shipping. 	Low (Unlikely x Minor)	<ul style="list-style-type: none"> Refer Item 25, above. No monitoring is proposed as part of this PER.

7.3.2 Air Quality

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.2.1 Mitigation Measures

The key objective of the air quality management measures is to manage particulate matter emissions from activities during the construction, operation and decommissioning phases. Air quality management will be included in an Air Quality Management Plan (AQMP), which will be implemented at the start of the construction phase, and also consider operational phase requirements.

Construction Phase

The following mitigation measures will be included to manage air quality impacts associated with construction activities:

- Vegetation will be cleared progressively as land is required for construction activities, to reduce exposed areas susceptible to wind erosion and dust generation.
- Disturbed areas that can be revegetated will be progressively revegetated and mulched to limit the duration of surface exposure.
- All access roads and internal roads will be sealed, and vehicle and mobile plant movement confined to those roads as much as practicable. Sealing of onsite roads will not occur until the end of construction.

- Material transported to the Project that has the potential to generate dust (including fill materials and road base) will be covered during transport.
- Wind conditions and forecasts will be monitored and taken into account when scheduling earthworks. Increased water truck usage will be employed for dust mitigation on windy days.
- On-site material movement will be planned to avoid stockpiling where practicable, and, where stockpiling is required, such that the duration of stockpiling is as short as practicable. For example, material will be excavated and immediately placed as fill, and imported materials delivered near the time they are required, wherever possible.
- Stockpile heights will be designed with maximum heights to reduce potential wind entrainment of materials.
- Dust suppression will be applied to stockpiles and other exposed surfaces. Wet suppression techniques will be used to reduce dust emissions from crushing and screening of road base, and from earthworks activities.
- Blasting work will be undertaken by personnel certified to design and execute blasting operations, and will be carried out considering wind direction and weather forecasts, but also in accordance with all relevant codes and government and regulatory requirements.
- Equipment, plant and vehicles will be serviced in accordance with manufacturer recommendations to promote their efficient running and hence minimise combustion product emissions.

Operational Phase

- Trucks will unload within a covered gantry (two sides and a roof), tipping payloads into a hopper through Burnley Baffles or similar. Burnley Baffles are a dust suppression device for reducing fugitive dust emissions from dump hoppers and chutes handling dry granular bulk raw materials such as grains and ores.
- The hopper head space, elevator and conveyor will be ventilated through a reverse air fabric filter before being discharged.
- The hematite shed will be serviced by a ventilation system and reverse air filters, 24 hours per day, to reduce fugitive dust emissions.
- The grain storage shed will be sealed and utilise dust collectors on all grain handling processes within the shed.
- Conveyors will be fully enclosed and serviced by ventilation systems with pulsed jet fabric filters at each of the conveyor transfer points to minimise fugitive dust emissions.
- Ship loading will be undertaken using appropriate dust controls, such as a loading chute with a cascade system that prevents free fall of material, or a chute that has a vacuum system around the exit point to capture dust.
- Equipment, plant and vehicles will be serviced in accordance with manufacturer recommendations to promote their efficient will be developed as part of the Air Quality Management Program.

Decommissioning Phase

If material handling or earthworks activities are required during decommissioning, these will be conducted in accordance with relevant air quality mitigation measures described for the construction and operational phases.

7.3.3 Greenhouse Gas Emissions

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6. Mitigation measures focus on the potential to utilise alternative energy sources, and to implement energy efficiency and conservation measures. Prior to the construction phase, an Energy Efficiency Plan (EEP) will be developed for implementation during the construction, operations and decommissioning phases of the Project. The EEP will include methods for:

- Monitoring and measurement of fuel usage
- Monitoring and measurement of electricity usage
- Estimation of GHG emissions and NGER reporting
- Identification, assessment and implementation of energy efficiency opportunities, and
- Principles of continuous improvement whereby review and update will occur such that new practices and measures can be implemented.

7.3.3.1 Mitigation and Management Measures

Construction Phase

- Energy efficiency and conservation measures, such as using high efficiency motors and generators, energy efficient lighting, and using automatic controls and timed systems will be assessed during detailed design phase.
- Source materials with low embodied energy or carbon footprints will be used where performance and efficiency is not compromised. Commitment to the purchase of local and recycled materials where possible.
- To fulfil reporting requirements under the NGER Act, fuel usage will be tracked during construction works. If the annual reporting threshold is triggered, energy and GHG emissions will be reported as required under the NGER Act.
- Investigate options to offset construction and/or operation GHG emissions, for example, under the Australian Government's Carbon Farming Initiative.

Operational Phase

- Connection to the Eyre Peninsula's electricity supply network will be considered when it has the capacity to provide sufficient electricity for the Project. It is understood that several companies are investigating the potential to develop a new transmission line and additional wind generation for the grid. Connecting to this "green power" when available, will reduce the GHG emissions associated with the Project's electricity requirements, as it will provide a lower emission option compared with use of on-site diesel generators.

- The generator configuration will be designed with consideration of energy efficiency. For example, a small generator may be used to supply the 0.5 MW demand expected at most times, and one or more large generators to supply the 5 MW demand expected during ship loading. Once electricity grid connection is established the generator use would be discontinued.
- Energy efficiency and conservation measures, such as using high efficiency motors and generators, energy efficient lighting, efficient dust suppression design, and using automatic controls and timed systems will be assessed and implemented where practicable.
- The transport scenario generating the lowest transport related estimated GHG emissions is the development of the Project. The Project will directly load Cape class vessels with products near to their source, which will provide savings on road transport impacts and economies of scale on shipping (compared to smaller Panamax vessels, which need to travel more frequently with smaller payloads). Providing a local port to accommodate Cape class vessels, where extensive overland transport is not required, has the potential to reduce transport-related GHG emissions by between 40% and 90% for ore, and by up to 50% for grain.
- Options to install small-scale renewable energy generation, such as solar, to supply electricity for office buildings will be investigated during the detailed design phase.
- To facilitate GHG emissions estimation and reporting required under the NGER Act, fuel and electricity use will be tracked during operations. If the annual reporting threshold is triggered, energy and GHG emissions will be reported as required under the NGER Act.

Decommissioning Phase

- As the Project is decommissioned, all shipping operations will cease. Electricity consumption will decline and the use of on-site plant and equipment will also decline until cessation. Therefore, GHG emissions will reduce and will become zero when decommissioning is complete.
- During this phase, fuel and electricity use will continue to be monitored to assess energy use and GHG emissions as required under the NGER Act. If a reporting threshold is triggered, energy and GHG emissions will be reported as required under the NGER Act.

7.3.4 Noise

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.4.1 Mitigation and Management Measures

Construction Phase

The key objective of the construction noise and vibration management measures is to manage noise from site activities during construction. The following mitigation measures have been identified:

- Use of low level noise reversing beepers.
- Ensure machines that are used intermittently one shut down in the intervening period between works or throttled down to a minimum.

- Vehicle warning devices such as horns should not be used as signalling devices.
- Silencers and enclosures will be appropriately maintained to ensure they are intact, the rotating plant is balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp.
- Traffic practice controls should be considered to prevent vehicles and equipment queuing or reversing near noise-sensitive locations.
- Using plant equipment that can achieve a similar outcome with less vibration, or modification of existing equipment to reduce vibration power levels.
- Implementing staging of the construction activities such that sufficient respite is provided between periods of high impact activity, particularly for night works.
- Developing a monitoring regime for both noise and vibration to ensure predicted noise and vibration impacts are maintained and met. This will be particularly important for activities such as piling.
- Source plant and equipment that performs at or better than industry expectations, as noise level emissions and potential annoyance depend significantly on the condition of the equipment.
- Look for opportunities to acoustically enclose generators and compressors.
- Acoustically screen individual activities where reasonable and practicable. Some activities suitable for screening are fixed operations. Effective screening depends upon the extent to which the noise source and/or the operator can be enclosed without hampering operation of the equipment.

Operational Phase

The Project already incorporates the following measures that assist in minimising noise to surrounding noise-sensitive locations:

- The Project is located a significant distance (about 1,000 m) from the majority of noise sensitive locations including residences.
- All unloading activities will occur in fully enclosed buildings.
- Conveyor belts will be fully enclosed.

To ensure the 40 dB(A) night-time goal noise level is achieved at all surrounding noise-sensitive locations, a number of acoustic treatments for generators were identified. These can be applied using a number of methods:

- Procurement of generators with the lowest practicable noise levels.
- Installation of enclosures and pacifier devices to air inlet and exhaust paths.
- Installation of local barriers, such as solid fences that block the line of sight between the generators and noise-sensitive locations.
- Location of generators inside a building.

For all mobile equipment on-site, noise will be managed through the installation of broadband reversing alarms, which emit a warning signal that is less invasive than common reversing alarms, but is still compliant with relevant safety requirements. Modelling undertaken on noise predictions from equipment with these identified mitigations measures in place has confirmed that the noise from the Project will achieve the 40 dB(A) night-time criterion.

7.3.5 Surface Water

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.5.1 Mitigation and Management Measures

The Project development and stormwater management will include the following:

- Water Sensitive Urban Design principles as discussed in Section 6.3.2, and
- Extended detention basin and additional onsite stormwater retention basin sized for 100 year storm event will be operated for stormwater detention.

A Site Water Management Plan (SWMP) will be developed including surface and stormwater management.

Construction Phase

Water quality and construction best management practices are contained in the *Code of Practice for the Building and Construction Industry* (EPA, 1999). The Project falls under the Building and Construction Industry category. The construction of the Project will follow the guidelines in the *Code of Practice for the Building and Construction Industry*.

The following strategy and practices will be implemented to optimise surface water management for the construction phase of the Project:

- Early construction and stabilisation of offsite catchment diversion channels and extended detention pond.
- Remove and stockpile topsoil for revegetation.
- Early revegetation of cut slopes and earthen channel.
- Erosion and sediment control.
- Non stormwater discharge and material management., and
- Extended detention pond can be used as a temporary sediment pond and is sized to contain the 100 year storm event thereby minimising the potential to discharge stormwater to the marine environment during the construction phase.

Operational Phase

Operation and maintenance of the diversion and flood control channels will include the following:

- Maintain vegetation and/or channel stabilisation for erosion and sediment control.
- Sediment control at energy dissipation basin/sediment trap.
- Remove sediment from channels on regular basis.

Decommissioning Phase

Surface water controls should still continue to function following decommissioning of the Project, until demolition and removal of the infrastructure. Therefore the same maintenance requirements will be in place during the decommissioning phase.

7.3.6 Groundwater

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6. Groundwater is not proposed as a water source for the Project and therefore the main potential impact to groundwater is considered to be contamination risk from possible chemical and fuel spills at site.

7.3.6.1 Mitigation and Management Measures

To assist with achieving the PER Guidelines' objectives regarding groundwater, mitigation measures have been identified which seek to minimise the potential impacts upon groundwater from activities undertaken within the Project area. They consider the construction, operation and decommissioning phases.

Construction and Operational Phases

- Low permeability hard stand surfaces will be constructed in operational areas that provide a barrier layer between the surface and underlying soils and groundwater.
- Site vehicles, earthmoving and construction plant and equipment will be maintained in accordance with manufacturer specifications and will be visually inspected daily to assess evidence of fluid or hydrocarbon leaks.
- Appropriate care will be taken during on-site refuelling or maintenance to minimise fluid or hydrocarbon spills. These activities are to be conducted on low permeability hard stand areas.
- All chemicals, fuels, oils, greases and solvents will be stored in low permeability bunded and covered locations in accordance with SA EPA *Bunding and Spill Management Guideline EPA 080/07* (EPA, 2007).
- Commensurate with the plant and equipment on-site, an appropriate number of spill and fluid absorbent kits will be provided. Staff will be trained in their use.
- Sanitary wastewater will be managed by on-site facilities in accordance with approval conditions. These facilities will be inspected and maintained in accordance with manufacturer requirements and approval conditions.

Decommissioning Phase

- Prior to decommissioning, stores of fuel, oil, chemicals and site consumables will be run down to minimise their remaining volumes upon the cessation of works.
- Additionally, upon decommissioning, all materials and waste, including those deemed to be potentially hazardous such as fuel, oil and other chemicals or residual materials which require removal, will be removed from site by an appropriately EPA licensed waste carrier.

7.3.7 Terrestrial Ecology

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.7.1 Mitigation and Management Measures

General construction and operational phase management measures are presented below, as well as specific discussion of the proposed approaches to revegetation, rehabilitation, SEB, weed and pest control. Detailed management plans and procedures would be developed prior to actual construction and operation phases.

Construction Phase

For the construction phase of the Project, a Construction Environmental Management and Monitoring Plan (CEMMP) will be developed, which will include mitigation, management and monitoring measures for impacts to terrestrial ecology. The details of these mitigation, management and monitoring measures will include the following:

- A Rehabilitation and Revegetation Plan will be developed, which will include erosion and sediment control, suggested local, native species for rehabilitation, minimise the need for fertiliser.
- A Weed Management Plan will be developed for construction and operations as part of site management. This will include onsite weed controls and monitoring.
- Controlling the movement of soil onto the Project from the surrounding area will be implemented to reduce the possibility of introducing new weed species. Similarly, all plant and machinery will be certified weed free before they are brought to the construction site.
- A designated wash down bay will be established before entering and leaving the Project area.
- Access to Rogers Beach by Project personnel will be restricted.
- All vegetation to be retained will be clearly demarcated on the ground and identified on a Project plan. Access to these areas will be restricted.
- During vegetation clearance, fauna found will be captured and relocated to adjacent suitable habitat.
- Any trenches and holes left uncovered for more than a day will be inspected for trapped fauna first thing in the morning and late in the afternoon. Any trapped fauna will be caught and released into nearby habitat.
- Stockpiles of materials and any associated infrastructure will be located in cleared areas in order to minimise impacts to vegetation.
- Construction machinery and vehicles will not be parked or stored within areas containing native vegetation.

Operational Phase

The details of these mitigation, management and monitoring measures will include the following:

- Strict policies will be adopted on managing food waste and littering within the Project area to discourage feral animals and birds.
- There will be continuous implementation of a feral animal eradication programme and weed management programme.

Revegetation and Rehabilitation Plan

A Revegetation and Rehabilitation Plan would be developed based upon the principal elements outlined below and would contain more detailed information regarding specific actions and the timing of those applications.

The creation of a SEB is a key element of the Revegetation and Rehabilitation Plan and the measures to deliver the required SEB are presented below, while the final details may involve further consultation with the Native Vegetation Council.

Significant Environmental Benefit

Native vegetation in South Australia is protected under the provisions of the *Native Vegetation Act 1991* (NV Act). The clearance of native vegetation requires approval in accordance with the NV Act unless it is subject to an exemption under the Native Vegetation Regulations 2003. An offset is required for the approved removal of native vegetation and this offset is known as a significant environmental benefit (SEB). This requires provision of replacement vegetation or equivalent compensatory payment into the Native Vegetation Fund that is greater than the area approved for clearance. The determination of the size of the SEB is based upon the quality of native vegetation, with highly disturbed areas that have not intact strata of native vegetation subject to a 2:1 hectare equivalent ratio, while a high quality vegetation remnant attracts a ratio of 10:1 (DWLBC, 2005). The requirement to provide a SEB is in addition to any on site rehabilitation requirements.

The SEB may be achieved in a number of ways that recognises that revegetation may not be the most successful method in terms of achieving enhanced biodiversity values. These methods include:

- Payment into the Native Vegetation Fund.
- Enter into a Heritage Agreement that acts to protect another area of native vegetation, and involves the establishment of an approved Vegetation Management Plan.
- Revegetate and manage an agreed area of native vegetation either on site or within the region.
- Manage and protect an area of native vegetation at the site.
- Undertake a range of activities to deliver the SEB off site, including but not limited to working with local government or other bodies to undertake environmental remediation or revegetation that is objective based.

Consultation with DENR, Native Vegetation Group/Native Vegetation Council may be necessary to establish the final details of the SEB and the mechanism by which it would be attained. Centrex proposes to undertake a SEB through the rehabilitation of the existing Low Shrubland Cliff Top vegetation association through a program of weed and pest animal control and selective revegetation. This program of SEB works would be complimented by revegetation in an area south of the site infrastructure footprint to re-establish Low Shrubland and Tussock Grassland communities in addition to the establishment of a Low Mallee vegetation association along Lipson Cove Road, as shown Figures 7-1 and 7-2. Centrex would also consider entering into discussions to provide or support native vegetation management in the vicinity of Rogers Beach that is adjacent to the project area, although at present this option has not been included in the calculation of the required SEB.

A SEB, as presented in Section 6, is required for the following proposed clearance of native vegetation, Table 7-6.

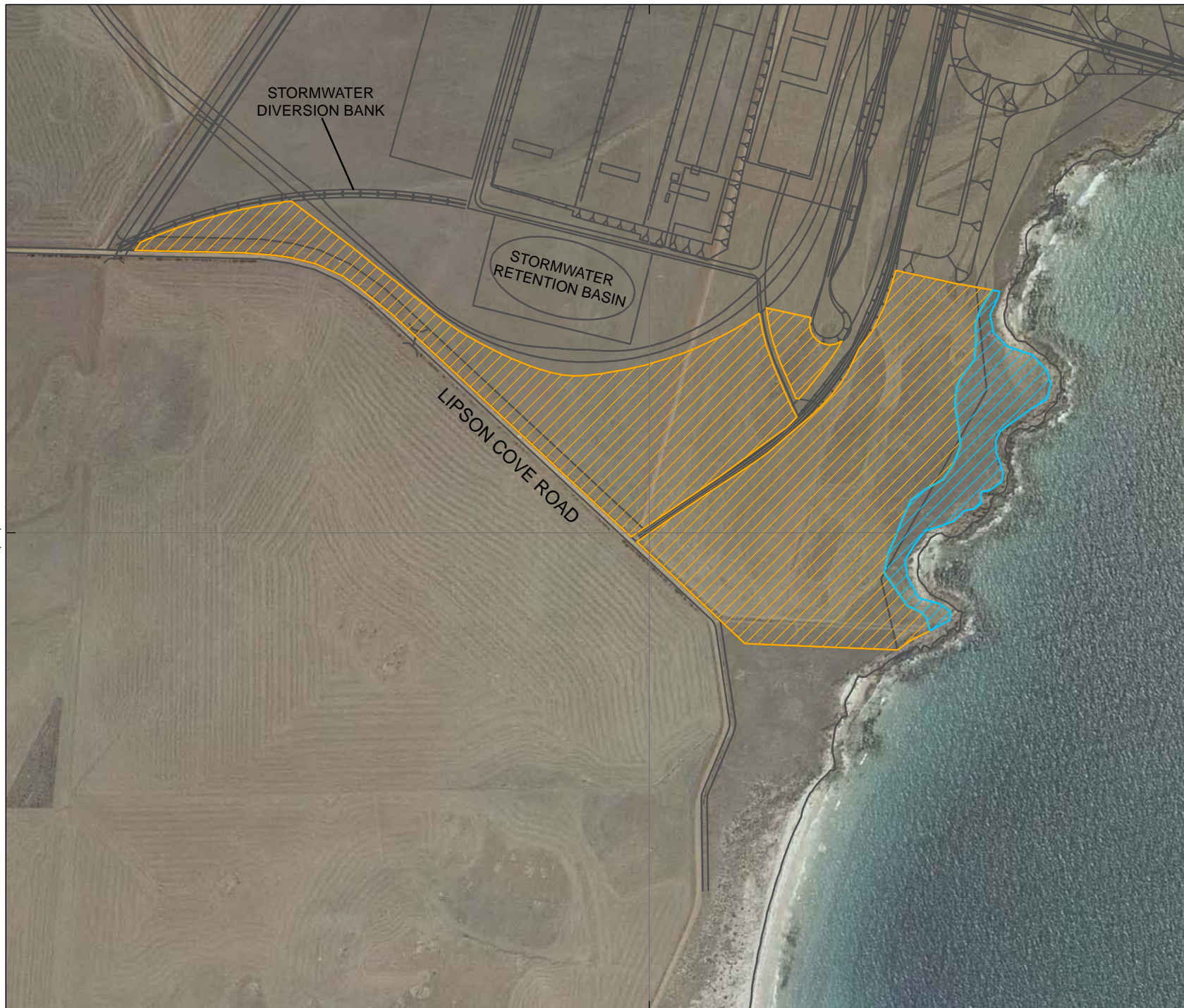
Table 7-6: SEB Requirements

Vegetation Description	Location & Reason	Area subject to clearance (ha)	SEB ratio	SEB Area (ha)
<i>Enchylaena tomentosa</i> (ruby saltbush), <i>Maireana brevifolia</i> (yanga bush) Low Shrubland over <i>Triodia irritans</i> (Porcupine grass)	Coastal cliff top would be removed for the construction of the conveyer and jetty infrastructure	0.77	5:1	3.86
<i>Nitraria billardierei</i> (dillon bush) Tall Open Shrubland over <i>Tecticornia sp.</i> (samphire)	Clay pan behind Rogers Beach would be removed for the construction of public access road and haul road	2.01	2:1	4.02
No substantially intact vegetation strata. Species present include: <i>Pittosporum angustifolium</i> (native apricot), <i>Allocasuarina verticillata</i> (drooping sheoak), <i>Austrostipa elegantissima</i> (elegant spear grass), <i>A. nodosa</i> (spear grass), <i>Austrodanthonia caespitosa</i> (Common Wallaby Grass). A complete description of the vegetation along Swaffers Road is presented in Appendix I.	Roadside vegetation is contained within a 5 m verge on both sides of Swaffers Road. Clearance required along 3.89 km to form a haul road.	3.89	2:1	7.78
Sub-Total Terrestrial SEB (ha)				15.66
Marine Vegetation				
Mixed meadows of <i>Amphibolis antarctica</i> , <i>Posidonia sinuosa</i> and <i>P. angustifolia</i> .	Shallower areas of seagrass habitat	0.13	10:1	1.32
<i>Posidonia sinuosa</i> and <i>P. angustifolia</i>	Deeper areas of seagrass habitat	0.33	10:1	3.39
Sparse <i>Heterozostera nigricaulis</i> and <i>Halophila australis</i>	Deeper areas	0.06	10:1	0.65
Sub-Total Marine SEB				5.36
Total Marine and Terrestrial SEB (ha)				21.02

A total SEB of 21.02 ha was estimated to offset both terrestrial native vegetation clearance and the proposed impact upon marine seagrass beds in the vicinity of the Port, refer Figure 7-1. A vegetation condition SEB ratio of 10:1 has been chosen for marine vegetation communities in the absence of clear offset guidelines and existing conditions. All SEB requirements would be met on land, due to the poor success rate of undertaking marine offsets and the inherent difficulties in maintaining and assessing a marine offset through planting seagrass.

The proposed SEB would be achieved on site through the revegetation of a 22.9 ha area of the southern portion of land adjacent to Lipson Cove Road (refer Figure 7-2). In addition, an existing area of 2.83 ha of ruby saltbush, yanga bush Low Shrubland coastal cliff top vegetation association would be rehabilitated through the implementation of environmental management measures including selective weed spraying, pest animal control measures targeting rabbits and selective revegetation and reseedling to improve structural complexity and biodiversity. Proposed SEB activities are summarised in Table 7-7, and remain subject to final Native Vegetation Council approval.

616,000



6,209,000

6,209,000

616,000

PROPOSED SIGNIFICANT ENVIRONMENTAL BENEFIT OFFSET



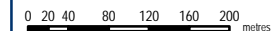
LEGEND

- Revegetation Area
- Vegetation Management Area

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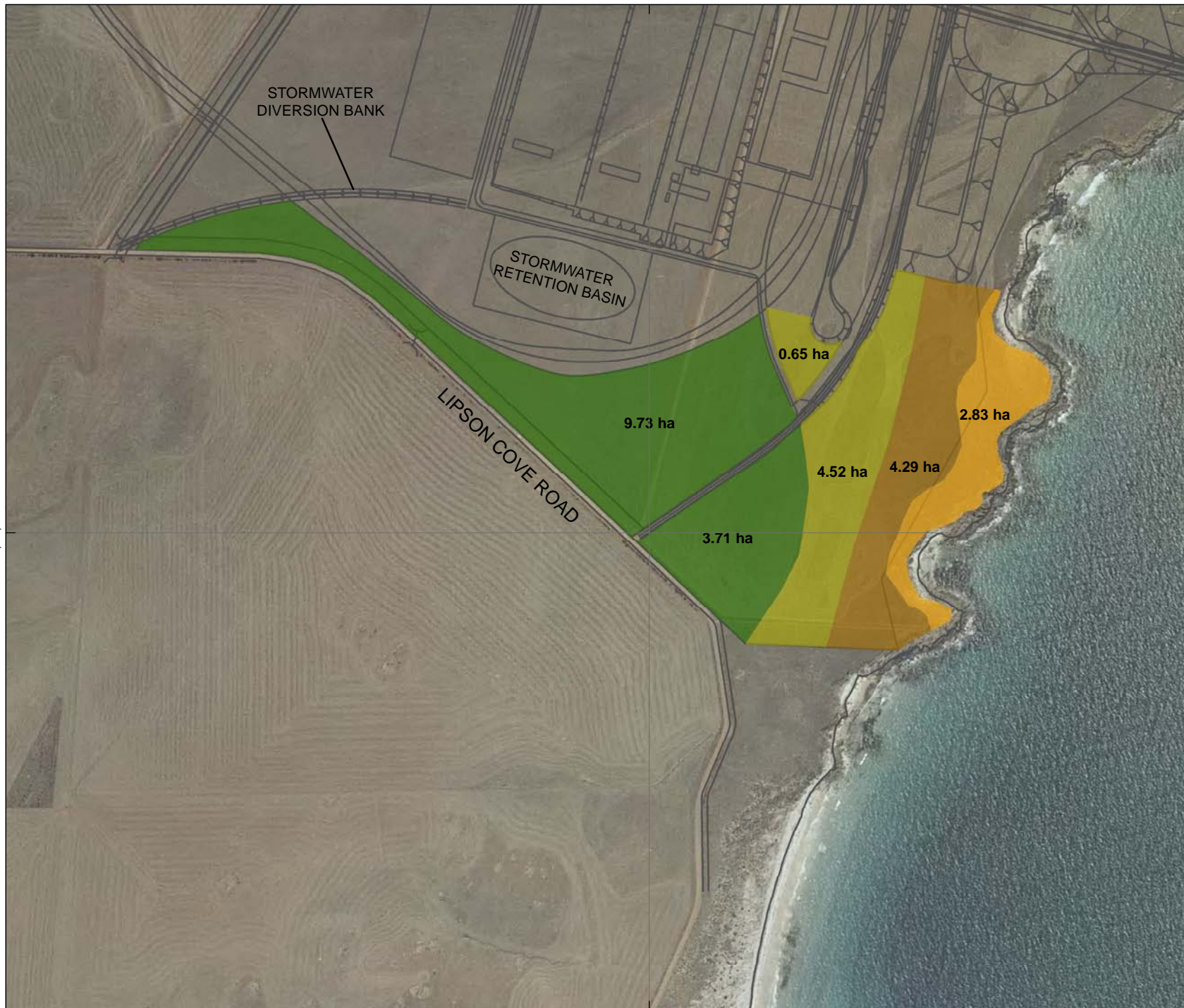
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 DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
 DRAWN: KB
 CHECKED: AMB

FIGURE 7-1



616,000



6,209,000

6,209,000

616,000

PORT SPENCER STAGE 1
PUBLIC ENVIRONMENTAL REPORT

PROPOSED SIGNIFICANT
ENVIRONMENTAL
REVEGETATION AND
REHABILITATION PLAN



LEGEND

- Mid Mallee Woodland - Revegetation
- Mid Hummock Grassland - Revegetation
- Low Open Shrubland - Revegetation
- Low Open Shrubland - Rehabilitation

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DATUM GDA 94, PROJECTION MGA Zone 53

PROJECT: 107661001
 DATE: 01 FEB 2012
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 CHECKED: AMB

FIGURE 7-2



The implementation of this proposed SEB of 25.73 ha in total would result in an overall SEB credit of 4.71 ha.

Table 7-7 Summary of Proposed SEB

Vegetation Association	Proposed SEB Area (ha)	Preliminary Plant Selection (Subject to availability and suitability to the chosen revegetation techniques. The following species lists are not limiting).
Mid Mallee Woodland	13.44	<p><i>Eucalyptus gracilis</i> (yorrell), <i>Eucalyptus socialis</i> (red mallee), +/- <i>Eucalyptus peninsularis</i> (Cummins mallee), +/- <i>E. leptophylla</i> (narrow-leaf red mallee) +/- <i>E. incrassata</i> (ridge-fruited mallee) +/- <i>E. calycogona</i> (square-fruited mallee) Mallee over tall shrubs <i>Melaleuca lanceolata</i> (dryland tea tree), <i>Melaleuca uncinata</i> (broombush), <i>Exocarpus aphyllus</i> (leafless cherry).</p> <p>Additional understorey species would be chosen to provide a complex understorey structure. Mid Hummock Grassland and Low Open Shrubland species listed in this table may be utilised. Initial plantings would contain a higher percentage of <i>Acacia spp</i> and other species known to be effective primary coloniser species. <i>Acacia</i> species suitable for consideration include: <i>Acacia anceps</i> (angled wattle), <i>A. calamifolia</i> (Wallowa), <i>A. cupularis</i> (cup wattle), <i>A. dodonaeifolia</i> (hop-bush wattle), <i>A. hakeoides</i> (hakea wattle), <i>A. halliana</i> (Hall's wattle), <i>Acacia ligulata</i> (umbrella bush), <i>A. notabilis</i> (notable wattle), <i>A. oswaldii</i> (umbrella wattle), <i>A. rigens</i> (needle bush wattle), <i>Acacia rupicola</i> (rock wattle) <i>A. sclerophylla</i> (hard-leaf wattle), <i>A. spinescens</i> (spiny wattle)</p>
Mid Hummock Grassland	5.17	<p><i>Allocasuarina verticillata</i> (drooping sheoak), <i>Triodia irritans</i> (Porcupine grass) with <i>Aristida behriana</i> (brush wire grass), <i>Austrodanthonia setacea</i> (small-flower Wallaby grass), <i>A. caespitosa</i> (common wallaby grass), <i>Austrostipa elegantissima</i> (elegant speargrass), <i>A. exilis</i> (heath spear grass), <i>A. hemipogon</i> (half-beard spear grass), <i>A. nodosa</i> (spear grass), <i>A. scabra ssp falcate</i> (slender spear grass), <i>Themeda triandra</i> (Kangaroo grass).</p> <p>A small number of species listed under the Low Open Shrubland vegetation association would also be utilised, in particular along the boundary between the communities, to create a diffuse boundary.</p>
Low Open Shrubland (revegetation)	4.29	<p><i>Acacia continua</i> (thorn wattle), <i>Acrotriche patula</i> (prickly ground berry), <i>Atriplex semibaccata</i> (berry saltbush), <i>Carpobrotus rossii</i> (native pigface), <i>Chrysocephalum apiculatum</i> (common everlasting), <i>Chrysocephalum baxteri</i> (white everlasting), <i>Dianella revoluta</i> (black-anther flax-lily), <i>Disphyma crassifolium</i> (round-leaf pigface), <i>Dodonaea hexandra</i> (horned hop-bush), <i>Dodonaea stenozyga</i> (desert hop-bush), <i>Enchylaena tomentosa</i> (ruby saltbush), <i>Frankenia pauciflora</i> (southern sea-heath), <i>Lepidosperma viscidum</i> (sticky sword sedge), <i>Lomandra effusa</i> (scented mat-rush), <i>Maireana brevifolia</i> (shortleaf bluebush), <i>Phebalium bullatum</i> (silvery Phebalium), <i>Pimelea glauca</i> (smooth riceflower), <i>Ptilotus seminudus</i> (pussy tails), <i>Rhagodia candolleana</i> (sea-berry saltbush) <i>Scaevola linearis</i> (rough fanflower), <i>Triodia irritans</i> (Porcupine grass), <i>Threkeldia diffusa</i> (coast bonefruit), <i>Vittadinia gracilis</i> (woolly New Holland daisy).</p>

Vegetation Association	Proposed SEB Area (ha)	Preliminary Plant Selection (Subject to availability and suitability to the chosen revegetation techniques. The following species lists are not limiting).
Low Open Shrubland (rehabilitation)	2.83	<p>Existing vegetation is to be managed with control of onion weed, bearded oat, wild turnip, red brome, galenia and African boxthorn and ice plant.</p> <p>Rabbit, fox and cat control are proposed to be conducted.</p> <p>Additional, infill plantings are proposed to increase the biodiversity of this vegetation association, including but not limited to: <i>Acacia continua</i> (thorn wattle), <i>Acrotriche patula</i> (prickly ground berry), <i>Atriplex semibaccata</i> (berry saltbush), <i>Carpobrotus rossii</i> (native pigface), <i>Chrysocephalum apiculatum</i> (common everlasting), <i>Chrysocephalum baxteri</i> (white everlasting), <i>Dianella revoluta</i> (black-anther flax-lily), <i>Disphyma crassifolium</i> (round-leaf pigface), <i>Dodonaea hexandra</i> (horned hop-bush), <i>Dodonaea stenozyga</i> (desert hop-bush), <i>Enchylaena tomentosa</i> (ruby saltbush), <i>Frankenia pauciflora</i> (southern sea-heath), <i>Lepidosperma viscidum</i> (sticky sword sedge), <i>Lomandra effusa</i> (scented mat-rush), <i>Maireana brevifolia</i> (shortleaf bluebush), <i>Phebalium bullatum</i> (silvery Phebalium), <i>Pimelea glauca</i> (smooth riceflower), <i>Ptilotus seminudus</i> (pussy tails), <i>Rhagodia candolleana</i> (sea-berry saltbush) <i>Scaevola linearis</i> (rough fanflower), <i>Triodia irritans</i> (Porcupine grass).</p>

A staged approach to delivery of revegetation works would be proposed and is considered to be standard practice. This approach allows scope for techniques and plant selection to be modified based upon results achieved, including failures, and is more accommodating of climatic variations. A staged approach is also reflective of the commitment to achieving the SEB objectives.

It is anticipated that following preparation of the areas to be planted direct seeding would be undertaken. The appropriate seeding application rates for each species would be determined in the future. Mechanical planting would not be undertaken amongst the existing coastal Low Open Shrubland vegetation rather seed would be hand broadcast following weed removal and preparation of the area to be sown. Disturbance of the existing vegetation would be minimised as it is important that this vegetation is retained so that natural regeneration can also be facilitated. Seed would be sourced locally (local provenance) or within the surrounding region subject to availability and approvals.

A detailed Revegetation and Rehabilitation Plan incorporating the principle discussed would be prepared and implemented subject to approval. It would provide guidance with regard to site preparation, planting, monitoring and ongoing maintenance.

Vegetation Rehabilitation

Proposed rehabilitative works are associated with:

- Primarily addressing disturbance during construction works and to a far lesser extent during Port operations., and
- Increasing the biodiversity value of Low Open Shrubland along the coastal cliff top (undertaken as a SEB component).

Key mitigation measures include:

- The clear demarcation and protection of native vegetation during construction phase.
- An environmental section within the worker induction process that advises all workers of their responsibilities with regard to protecting native vegetation at the site.
- Where native vegetation is impacted either during the construction or operational phases, the incident will be investigated and corrective measures implemented as required.

Weed and Pest Management

A weed and pest management strategy for the whole site would be developed in the future so that potential weed infestation sources are controlled and the success of revegetation activity is maximised. Pest control measures would be employed across the entire property. The Weed and Pest Management Plan (WPMP) would be developed in consultation with the Eyre Peninsula Natural Resource Management Board (EP NRM) and meet the statutory requirements of the *Natural Resources Management Act 2004*. The WPMP would be developed in consideration of the Natural Resources Management Plan for Eyre Peninsula (EP NRM 2009a) and the EP NRM (2009b) Monitoring, Evaluation, Reporting and Improvement Framework in addition to relevant technical guidelines and regional threatened species recovery plans.

Pest control measures would be implemented as required (e.g., plague locusts), and as part of a long term integrated pest control program (e.g., rabbit control). There would be a component of reactive works in addition to a program of programmed work that would be developed on a species specific basis. Programmed work would be reviewed annually to allow changes that reflect the on-ground situation to be incorporated.

Revegetated areas are to be monitored, as a minimum, in June following seeding/planting and again in September (spring).

Standard methods should be deployed for monitoring rabbit numbers (Mitchell and Balouh, 2007), and a response with targeted control measures should be made when evidence of an increase in numbers exceeds an agreed threshold, or when damage to plantings from over-browsing exceeds an agreed threshold.

Weeds need to be controlled on the site, although at present they provide an acceptable vegetation cover to stabilise the soil surface. However, the cost of allowing this weed cover to remain is the increased contribution to the seed bank of weed species that may ultimately need to be controlled in order to facilitate the establishment of native vegetation or to meet obligations upon the landowner under the *Natural Resources and Management Act 2004*. Weed control would commence prior to revegetation. Generally, weed control is undertaken in advance of planting (over a 6-12 month period) and is targeted to the species present. As native vegetation becomes established bush care methods of weed control may become more appropriate.

Spot spraying would be utilised within areas of existing native vegetation prior to sowing or planting to reduce weed competition. Spot spraying or other bushcare methods reduce the off target herbicide impacts.

Areas to be planted or seeded would likely be treated with a broad spectrum herbicide in the weeks prior to planting so as to reduce competition from weeds. The non-target vegetation would be protected during any follow up spraying. Weeds of particular note across the site include the Declared weed species under the NRM Act 2004, **Marrubium vulgare* (horehound) and **Asphodelus fistulosus* (onion weed) (* indicates an introduced species). Additional weed species of concern are **Argyranthemum frutescens* (Marguerite daisy) that is present in the sand dunes associated with Rogers Beach, **Lycium ferocissimum* (African boxthorn) and **Mesembryanthemum crystallinum* (iceplant) that invades disturbed areas forming extensive carpets.

7.3.8 Lipson Island

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.8.1 Mitigation and Management Measures

As a designated conservation reserve and managed under the NPW Act, the South Australian Department of Environment and Natural Resources (DENR) is responsible for management of Lipson Island and the Lipson Island Conservation Park. Centrex will undertake management and monitoring within its control to minimise the potential impact of the Project upon the environmental values identified for Lipson Island. Potential impacts to Lipson Island are expected to be managed through general control measures at the Project relating to noise, construction, air and marine management measures.

Measures to mitigate the potential impacts are outlined in this section.

- Domed focussed low level light will limit potential light impacts at Lipson Island.
- Measure and monitor light pollution in the vicinity of Lipson Island seabird rookery during construction and operation to qualify predicted impacts and determine if further mitigation is required.
- Centrex will develop and implement a Silver Gull Management Plan for construction, operation and decommissioning phases of the Project that includes, but is not limited to, the following:
 - Eliminating waste food that may be scavenged.
 - Monitoring Silver Gull populations and impacts at the Project.
 - Guide for staff access and behaviour by signage, inductions, educational briefings, workshops and other educational material.

7.3.9 Soils

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.9.1 Mitigation and Management Measures

Construction Phase

A CEMMP will be developed and present the mitigation and management measures for impacts to Project area soils. Proposed details for the CEMMP include the following:

- Design of site layout and surface levels to optimise cut and fill, minimising any requirement to import material onto the Project area.
- Measures will be identified to allow for all suitable material excavated during construction to be re-used in the completion of civil works.
- Topsoil removed as part of civil will be stored for reuse in site revegetation activities.
- Erosion and sediment control measures, in the form of a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared to:
 - Limit the amount of land exposed to the risk of wind and water erosion for the shortest period of time.
 - Install sediment control structures in the Project area prior to earthworks commencing, which will control and divert water around the construction site to minimise flow over non-vegetated construction areas.
 - Install erosion control and sediment collection structures for site drainage in accordance with the EPA's *Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry* (EPA 1999).
 - Temporarily mulch all areas cleared of vegetation (for example, hydromulched, or covered with biodegradable matting), if to be developed later, or permanently rehabilitated to limit the exposed surfaces and prompt revegetation, or they will be sealed (i.e. pavements, etc.) following construction.
 - Locate stockpiles away from concentrated expected water flow and drainage paths.
 - Appropriately bunded spoil stockpiles with catch drains, and cover with a sterile cover crop if they are to be left for more than 30 days.
 - Place trench spoil parallel to and up-gradient of excavations, so that any runoff will be trapped in the trench.
 - Backfill and compact trenches and rehabilitate, as soon as practicable.
 - Temporarily stabilise watercourse banks and crossings that are to be disturbed until more permanent stabilisation is carried out (i.e. revegetation, gabions, etc.).
 - Outline minimum standards and requirements for rehabilitation and revegetation, including road shoulders and adjacent swales.
 - Specify conditions under which erosion control or sediment collection structures can be decommissioned.
- Provision of fencing and other controls to limit access to Rogers Beach, especially from vehicles, for the purpose of preventing erosion. This would only be done at the Centrex block boundary and apply to construction workers only as Centrex does not own Rogers Beach.

- All waste to be stored on-site in such a manner so as to prevent any materials from contaminating soil and other environmental receptors.

Operational Phase

For the operational phase of the Project, and Operational Environmental Management and Monitoring Plan (OEMMP) will be developed. That plan will include, amongst other aspects ongoing monitoring and maintenance requirements for rehabilitated and revegetated areas.

Decommissioning Phase

Similarly, for the decommissioning phase, a Decommissioning Management Plan will be developed as required.

7.3.10 Marine Ecology

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.10.1 Mitigation and Management Measures

A number of mitigation measures would be implemented during both the construction and the operation phases of the Project. The implementation of mitigation measures would assist with reducing potential impacts to marine mammals. It is predicted that marine mammals may either habituate to the noise generated from Project activities, or they may leave the area temporarily to avoid behavioural disturbance. All species are predicted to return once the activity has been completed. No effects at the population level are anticipated.

It has been noted that the degree of adverse impact on the seagrass and macroalgal habitats at the Project can be considered minor, with a relatively limited areas being disturbed or removed by the construction and operation phases.

The following measures would assist with minimising the potential impact on the marine environment.

- End-over-end construction of the jetty, will assist with minimising impacts of marine habitats.
- Development of targeted construction Environmental Management Plans, which would include measures such as:
 - Pile fabric filtering during pile driving and drilling activities to reduce the potential for increase turbidity.
 - Spill, erosion and sediment control equipment used for all possible pollutants which are likely to be generated through construction.
- Development of an Emergency Response and Incident Management Plan prior to the commencement of works. The plan would include environmental incident response requirements, both for water quality, marine flora and fauna.
- In-built structural pollution controls (such as enclosed conveyors) are included in Project description to minimise loss of product during ship loading activities.

- Vessel management practices which aim to decrease the potential for turbidity and disturbance to sediments. Such measures would ensure that vessels are not under their own power within 1.5 km of the jetty, with tugboats being the only vessels permitted to operate in the area.
- Ballast water management procedures to be implemented by incoming vessels in compliance with national requirements.
- Mitigation measures to manage material generated by drilling activities associated with pile installation which could impact water quality (i.e., turbidity or contaminants) would be implemented as part of the CEMMP.
- Foreign crews would not be permitted to leave vessels while berthed at the Port. To ensure this is enforced, site security controls would be implemented as part of port operations.
- Fishing by personnel working on the port would be discouraged at the Project.
- The principles of ‘best management practice’ (BMP) and ‘best available technology economically achievable’ (BATEA) would be applied in order to minimise potential impacts on marine mammals from pile driving activities including:
 - When impact pile driving, employ where possible a “ramp up” or “soft start” technique to give adequate time for marine mammals to leave the vicinity before exposure to the maximum sound pressure level.
 - Marine mammal monitoring would be implemented during all impact pile driving activities. A 500 m safety perimeter would be visually monitored around the pile being driven to monitor for presence of marine mammals. Piling would cease if marine mammals are sighted within 500 m of the work area.
 - Construction of the marine structures would begin onshore and would advance seaward, allowing for an extended period of response time by acoustically sensitive marine mammals in the area (by means of avoidance or habituation).
 - The approach to pile installation for the marine structures would include preferential use of vibrational pile driving over impact pile driving (where possible), as the latter is associated with louder sound pressure levels underwater.
 - Noise insulation measures would be identified as part of the CEMMP’s consideration of marine piling activities and other marine based activities.
 - No mitigation measures are proposed for vibrational pile driving, pile drilling, and vessel traffic, as noise generated during these activities is not anticipated to reach levels that would result in injury to marine mammals.
 - Notwithstanding this, underwater noise monitoring would be undertaken during initial pile driving activities to verify that the noise signals being generated do not overly exceed the modelling predictions used in this risk assessment.

Discussion of vegetation SEB offsets is provided in Section 7.3.7.

7.3.11 Traffic

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.11.1 Mitigation and Management Measures

Proposed Road Upgrades

A number of road upgrades have been identified for both Swaffers Road and Lipson Cove Road between Lincoln Highway and the Project to cater for the increased traffic volumes and vehicle types expected to use these roads.

Swaffers Road

Measures identified to upgrade Swaffers Road include the widening and sealing of the road carriageway to cater for the expected heavy vehicles to be used to transport minerals and grain to the Project. The upgrade of the road would consider design factors such as the desirable speed limit of the upgraded road, desired operating speed of the heavy vehicles which will then influence the radius of horizontal and vertical curves along the road. Given the lack of abutting development that is currently present, it is reasonable to expect a 100 km/h speed limit to be applied to an upgraded Swaffers Road.

In terms of junction upgrade with Lincoln Highway, the treatment would consider the existing junction of Berryman's Road with the Lincoln Highway, which lies approximately 40 m south of the Swaffers Road junction. Berryman's Road is an unsealed road under the care and control of the District Council of Tumby Bay. Berryman's Road connects through to Butler Centre Road that provides access to the northern interior of the Eyre Peninsula.

While the projected traffic volumes associated with the Project are relatively low, as are the through volumes along Lincoln Highway, there is potential for concern from a safety perspective in relation to having heavy vehicles waiting in the through lane to turn right into Swaffers Road, or equally right turning out of Swaffers Road to travel north. *Publication No: AGRD04A-10, Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads, 2009) is meant to justify the provision of only the basic junction treatment (i.e. localised widening on Lincoln Highway to enable a vehicle to pass a right turning vehicle), the provision of a channelised right turn lane is considered most suitable given the vehicle types that will be used the junction as the designated heavy vehicle access to the Project. The design will also need to consider providing access requirements for Berryman's Road.

Currently Swaffers Road rises on grade to the junction with the Lincoln Highway. It is considered important that a level area, capable of storing the largest vehicle expected to use the Project, is provided at the intersection to enable the vehicle to wait for an appropriate gap in the traffic stream and be able to accelerate at a maximum rate, rather than having to also contend with moving off from an uphill grade. This would require significant earthworks to be undertaken on the Swaffers Road approach to achieve this. There may be implications for existing services such as overhead power and telecommunications associated with this work that would need to be considered during the detailed design of the intersection.

The at-grade junction solution has been designed to generally be in accordance with Austroads (2009) *“Guide to Road Design Part 4A: Unsignalised and Signalised Intersections”* and some initial discussions have been held with representatives from the Department of Transport, Energy and Infrastructure (DTEI). Further discussion will be undertaken with DTEI (now known as the Department of Planning, Transport and Infrastructure, DPTI) through the detailed design phase to reach agreement on the scope of the improvement, particularly as it relates to providing acceleration lanes for heavy vehicles. Figure 7-3 provides a concept design for this junction upgrade.

At the intersection of Coast Road and Swaffers Road, Centrex would recommend to the Tumby Bay District Council that the priority control be changed, such that Swaffers Road through movements have priority, given Centrex would be the highest traffic volume. Appropriate traffic control signs could include advance intersection warning signs and advance give-way ahead signs, with supplementary distance plates installed on the Coast Road approaches. Such a treatment would give drivers approaching the intersection sufficient advance notice of their approach to the intersection to prepare to stop their vehicle. The change of priority would also provide for more efficient movement of heavy vehicles to and from the Project, as they would not be required to stop and give-way to other vehicles at the intersection. The change in priority will require Tumby Bay District Council endorsement.

To improve the sight distance at the intersection, some simple treatments, such as trimming vegetation from road verges and appropriate intersection warning signs would be recommended to the Tumby Bay District Council. This would be confirmed with a detailed engineering survey at detailed design stage. It would be desirable to seal Coast Road for at least 130 m on the southern approach and 180 m on the northern approach to the intersection to provide safety and maintenance benefits, particularly within the intersection, as the likelihood of loose gravel being deposited within the intersection and creating a safety hazard will be significantly reduced. This will be discussed further with DPTI and Tumby Bay District Council during detailed design. A sealed surface on the Coast Road approaches would also provide a safer approach conditions, should a vehicle be required to brake heavily due to potential vehicle conflict on the approach.

Lipson Cove Road

As a mitigation measure, it has been identified to seal Lipson Cove Road from the junction with Lincoln Highway through to the access to the Project to cater for passenger vehicles, including buses that will be accessing the site during the construction phase.

At the junction, similar to the Swaffers Road junction, because of the relatively small traffic volumes expected to be encountered at this location, the Austroads Guide indicates that only minor road widening to provide a Basic Right Turn treatment is warranted. However, it has been identified as a further mitigation measure to implement a channelised junction as a consideration to employees, as well as providing a benefit for tourists and others accessing the Lipson Cove area. Figure 7-4 provides a concept plan indicating the required extent of works for such a junction upgrade.

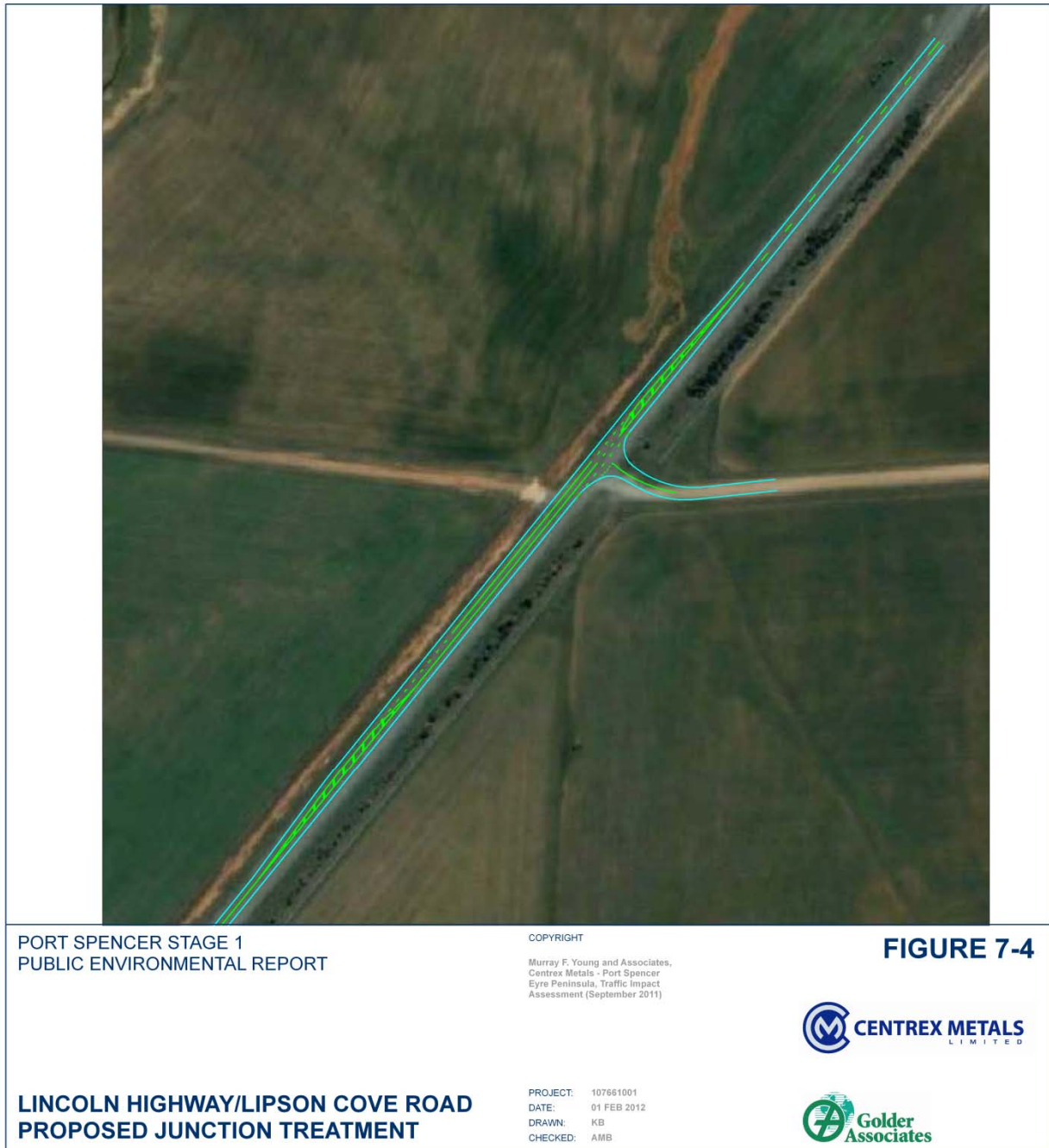
At the Coast Road intersection, Lipson Cove Road is the priority movement. Apart from some minor vegetation trimming or removal to maintain sight lines, no other works are considered necessary. Similar to the Swaffers Road/Coast Road intersection, it is considered appropriate to seal both approaches of Coast Road for a distance of 150 m each for safety and maintenance reasons. In relation to the proposed light vehicle access road location, there is insufficient sight distance available at the proposed location, due to a crest in Coast Road to the west of the proposed access. It has been identified that the proposed Project access road location can be moved to ensure there is sufficient sight distance available. The alternatives are either to the top of the crest, or on the bend as the Lipson Cove Road turns south towards the campsite at Lipson Cove.

Figure 7-3: Lincoln Highway/Swaffers Road/Berryman’s Road Concept



Source: MY&A, 2011

Figure: 7-4: Lincoln Highway/Lipson Cove Road Proposed Junction Treatment



Source: MY&A, 2011

Planning

The proposed upgrades to the arterial road have been discussed with officers from DPTI at a concept level, but would require further detailed negotiations to agree on the junction treatments should the project proceed. Centrex has commissioned preliminary design for Swaffers Road and Lipson Cove Road junctions. Centrex's intent is to implement junction works and seal Lipson Cove Road and Swaffers Road subject to DPTI approval.

Parking

A truck preparation area and parking area has been included in the Project design along the haul road on the northern side of the Project. Parking for light commercial vehicles would be provided adjacent to the main office and administration building. Parking for operations staff for the proposed grain and hematite facilities would be provided adjacent to the storage facilities. A minimum of thirty car spaces would be provided in the main carpark, and a minimum of ten spaces on each of the storage facility sites.

7.3.12 Heritage

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.12.1 Mitigation Measures

A precautionary approach to impact mitigation is proposed for heritage aspects. This would include, yet not necessarily be limited to, the following.

- Prior to any construction activities occurring, a physical inspection of the Project area would be undertaken, in consultation with the local Indigenous heritage representatives.
- Standard procedures would be developed and implemented on-site for the Project to redress discovery of items or sites of heritage significance and ensure appropriate stop work processes are implemented.

7.3.13 Visual Aesthetics

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6.

7.3.13.1 Mitigation Measures

Visual amenity can be mitigated in the long-term by the decommissioning/removal of facilities and reclamation of developed areas. Table 7-8 summarises the impacts and recommended mitigation that would be implemented as part of construction and operation.

Table 7-8: Visual Mitigation Measures

Potential Impact	Proposed Mitigation
Project visibility from Lipson Cove Road and Lipson Cove Beach	Planting of trees and shrubs (2 - 4 m height) on Lipson Cove Road along southern boundary of Project.
Colour and texture of facilities visibility	Usage of sea blue or an earth tone paint colour for most facilities.
Night-time lighting of facilities visibility	Domed focussed low level lighting to be placed within Project area.

7.3.14 Waste and Materials

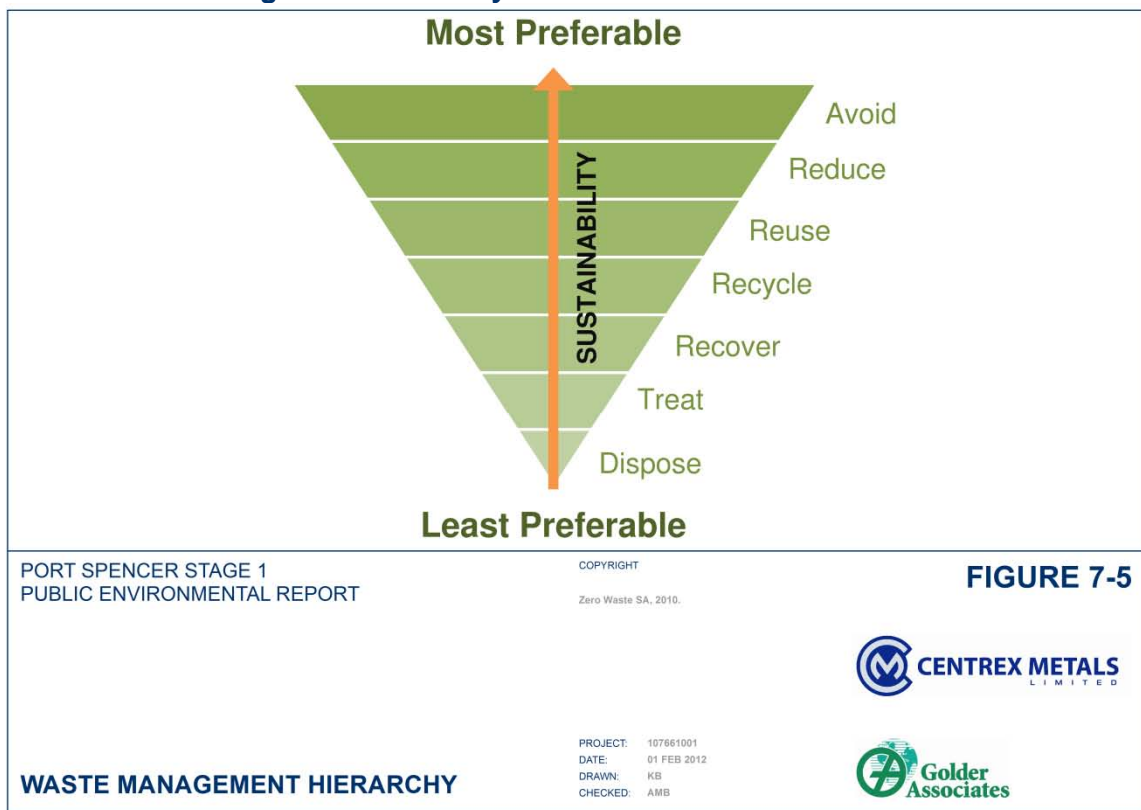
This Section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6. Measures proposed reflect consideration of the Draft *South Australia Waste Strategy 2010 -2015*.

7.3.14.1 Mitigation and Management Measures
Draft South Australia’s Waste Strategy 2010 - 2015

The Draft *South Australia’s Waste Strategy 2010 – 2015* (the Strategy) was used as guidance for managing impacts associated with waste generation and material consumption, and to address relevant requirements of the Project guidelines. A summary of key aspects of the Strategy, and how they have been applied to the Project, is provided below.

The Strategy guides South Australia’s recycling and waste avoidance efforts for the 2010 to 2015 period. The long term strategic objectives of the Strategy are to ‘avoid and reduce waste’ and to ‘maximise the value of our resources’. The Strategy also describes the waste management hierarchy, which is presented in Figure 7-5. The waste management hierarchy is an internationally recognised aspirational framework for managing waste generation and disposal. The Strategy strives to reach the higher levels of the waste management hierarchy.

Figure 7-5: Waste Management Hierarchy



Source: ZeroWaste SA, 2010

To apply principles of the Strategy to the Project, anticipated waste generation and material requirements were first identified. These wastes and materials are outlined in Section 6. Strategies to implement waste management measures that achieve higher levels of the waste management hierarchy were then addressed. Options to avoid and reduce waste generation and resource demand (the highest preferences in the waste management hierarchy) are inherent in the Project design, and are not described explicitly in this section.

The site includes consideration of reuse in the current design. It is intended that, spoil generated by site cutting and filling activities would be reused during construction for road construction road construction and other site earthworks to minimise the use of virgin materials for these purposes. Infrastructure will be primarily composed of steel materials, which also contain recycled content and it is recyclable at end of life which can avoid it becoming a waste product. A procurement policy would be developed by Centrex to encourage purchase and use of materials with recycled content, minimal packaging and materials that can be recycled at their end of life. Contractors and suppliers would be expected to reflect policy requirements in their procurement activities. This supports reuse, waste avoidance and reduction principles as described in the Draft *South Australian Waste Strategy 2010 – 2015*.

Where direct waste reuse was not practical, options to apply approaches lower on the waste management hierarchy were considered. General principles considered for implementation are listed within this section. Management and mitigation measures were developed based on the above approach. They are presented later in this section.

Waste Generation

Common to the construction, operational and decommissioning phases is the need to develop and implement a Waste Management Plan (WMP). The WMP would include principles of continuous improvement whereby review and update would occur such that new practices and measures can be implemented. The WMP would reflect the State Waste Strategy, applying the principles of the waste management hierarchy where practicable and describe how waste would be classified, stored, managed, monitored and disposed. It would also include the requirement for all waste to be removed by an appropriately EPA licensed waste transporter for disposal or recycling at an appropriately licensed EPA waste or recycling depot. The WMP will include the following key aspects:

- A system of waste tracking to record waste amounts, types and identity of the waste transporter and disposal destination
- Provision for an annual audit of waste management strategies, their implementation and reporting
- Implement source separation of waste streams to maximise recycling opportunity
- Divert appropriate waste streams to recycling facilities
- Ensure appropriate treatment and disposal of residual waste
- Reuse waste materials in site processes or applications where appropriate
- Source recycled materials
- Source local materials, and
- Source materials based upon demand to minimise wastage

To assist with achieving strategic waste objectives identified above, a number of mitigation measures have been identified which seek to minimise the volume and types of waste produced. They consider the construction, operational and decommissioning phases of the Project and also address materials sourcing and waste reuse opportunities, while suggesting management tools and methodologies.

Construction Phase

- Topsoil
 - During construction, topsoil would be stripped from areas that are being developed. This material is a resource and would be reused as a vegetative growth medium during related revegetation activities.
- Site Layout and Levels
 - Project layout and levels have been designed to optimise cut and fill, minimising requirements to import materials to, or dispose of waste from, the site. All suitable material excavated during construction would be re-used on-site in the completion of civil works.
 - Excavated materials that are suitable for use as road base would be crushed and used for that purpose on Swaffers Road, and/or for the final compaction layer of the construction pads. Other excavated materials would be used as general fill for the Project. Preliminary earthworks design has been undertaken and predictions from this work indicate that no excess spoil will be generated.
- Road Construction
 - Additional materials required for road construction (such as clay and aggregate) and for fill at the Project would be sourced from suppliers on the Eyre Peninsula as far as possible.
 - Quarry products (such as aggregate) would be sourced from local quarries and concrete from local concrete plants. Preliminary enquiries with local contractors have indicated the presence of suitable quarries for supply of this material on the Eyre Peninsula. Opportunities to use recycled building products, would also be considered for the construction phase.
- Infrastructure Fabrication
 - Off-site fabrication of structures would be undertaken to support resource efficiency at the construction phase. This is intended to reduce requirements for material import for the Project, and reduces the likelihood of on-site waste production associated with fabrication of these structures.
- General Waste Management
 - Generation of large volumes of general and mixed waste from the construction phase is not expected. Waste would be removed from the Project by an appropriately EPA licensed commercial waste and recyclable removal and transport contractor on a regular basis. It would be source-separated to improve the potential for the recycling of suitable materials. This contractor would dispose of waste or deliver recyclable material at appropriately EPA licensed waste or recycling depots.

- Sewage and Effluent Management
 - Temporary ablution facilities would be installed at the Project. Sewage and effluent generated by these facilities would be managed and disposed of through an approved waste control system, with capacity to manage volumes of sewage and effluent generated by up to 200 site personnel.
- Stormwater
 - Where possible during construction, stormwater would be harvested from the site catchment and stored for re-use for compaction, dust suppression, vehicle wash down and other non-potable applications. This would reduce requirements for water supply and will reduce requirements for stormwater disposal.

Operational Phase

- General Waste Management
 - Generation of large volumes of general and mixed waste from the operation phase is not expected. However, that which is produced would be removed from site by an appropriately EPA licensed commercial waste and recyclable removal and transport contractor on a regular basis. It would be source-separated to improve the potential for the recycling of suitable materials. This contractor would dispose of waste or deliver recyclable material at appropriately EPA licensed waste or recycling depots.
- Sewage and Effluent Management
 - A package plant would be installed to treat effluent from 40 people and treat washdown water to a water standard suitable for disposal via irrigation around the Project area.
- Stormwater
 - During operation, stormwater would be harvested from the catchment and stored for re-use for compaction, dust suppression, vehicle wash down and other non-potable applications. Both surface water run-off and rain falling on rooftops would be captured.
- Ballast Water
 - Pursuant to the Australian Quarantine and Inspection Service (AQIS) “*National Seaports Program – Australian Ballast Water Management Requirements, version 5*”, dated 10 August 2011, foreign ballast water is not to be discharged within Australia’s territorial sea (the area within 12 nautical miles of the Australian coastal baseline). Management of discharge outside Australia’s territorial sea area is governed by these mandatory AQIS requirements. They also include methods of ballast water exchange that are acceptable to AQIS, such that when a vessel arrives in port its ballast water is not considered foreign and can be discharged during loading at the Project.

Decommissioning Phase

- Removal of Materials and Waste Products
 - Prior to decommissioning, fuel, oil, chemicals and consumables would be run down to minimise their remaining volumes upon the cessation of works. This reduces the need for the off-site transport and disposal of these materials.

- All waste materials, including those deemed to be potentially hazardous such as fuel, oil and other chemicals or residual materials which require removal, would be removed from site by an appropriately EPA licensed waste transporter.

7.3.15 Socio-economics

This section outlines the mitigation and management measures proposed as an outcome of the impact assessment provided in Section 6. The socio-economic mitigations are recommendations and more detailed measures would be confirmed closer to operation and related contractual arrangements with operators and contractors.

7.3.15.1 Mitigation Measures

- Employment and Training
 - Centrex, and its contractors, would open all employment positions to local people, where the skills and qualifications of the applicants are otherwise equal.
 - Centrex, and its contractors, would open all training positions (e.g., apprenticeships) to locally based applicants to increase local capacity and skill sets.
- Housing
 - Centrex, and its contractors, would provide accommodation for fly in/fly out workers during construction, most likely at a purpose-built village adjacent to Tumbay Bay.
 - Centrex would provide accommodation for fly in/fly out workers during operation, most likely at a purpose-built village adjacent to Tumbay Bay.
- Electricity
 - Centrex would pay the capital costs required to extend the ElectraNet transmission line to the Project for operations. Electricity would be self-sourced during construction.
 - Centrex's development of the Project and its mines has the potential to bring forward ElectraNet's scheduled upgrade of the Eyre Peninsula's transmission line upgrade.
- Water
 - Centrex would pay the capital costs required to extend the main water pipeline from the intersection of Swaffers Road and Lincoln Highway to provide water services to the Project.
 - Stormwater would be harvested on site for reuse, where feasible, and environmentally advanced waste water treatment would produce reclaimed water for irrigation. The project reflects the principles of WSUD.
- Local Business
 - Centrex, its contractors and the Project operator, would seek to engage local suppliers where their services and skills are competitive, during construction and operations.
 - Centrex would seek to build capacity with local suppliers by developing a business register.

- Local Services
 - Centrex, and its contractors, would maintain ongoing communications with local emergency services including SA Police, health providers, fire services and the State Emergency Service.
 - Centrex would undertake consultation with Tumby Bay Hospital and local ambulance service prior to the start of construction and conduct a risk assessment of local capacity for responding to anticipated requirements during construction.
 - Centrex, and its contractors, would seek to engage local emergency services in training drills and other preparations for potential emergency scenarios.
 - Centrex, and its contractors, would keep local emergency services informed of expected construction and operations works schedules and aspects.
- Social
 - Centrex, and its contractors, would appropriately manage worker behaviour through a Code of Conduct which would be clearly communicated and enforced with all Project staff (during construction and operation).
 - Worker accommodation would likely provide high quality facilities including catering, internet and recreational facilities.
 - Centrex would continue to provide support to community groups/programs by way of donations/sponsorship in accordance with Centrex policy.
 - Centrex would maintain public access to Rogers Beach and the Lipson Cove campsite throughout construction and operation of the Project.
 - After construction and during the operating phase, pedestrian access along the coast (under the jetty) would be maintained.

The socio-economic assessment has outlined the potential social and economic effects for the construction and operation of the Project. A summary of key impacts, mitigations and management measures is provided Table 7-9.

Table 7-9: Summary of Key Socio-economic Impacts, Mitigations and Significance After Mitigation

Impact	Mitigation / Management Measure	Significance After Mitigation
<p>Available jobs: 200+ for construction and up to 70 for operations.</p> <p>Available training: 7 during construction and 5 during operations.</p>	<p>Open all positions and training opportunities to local applicants with equal skills and qualifications.</p>	<p>Local unemployment reduced and greater opportunities for employment and training; local economic growth.</p>
<p>200+ construction workforce require accommodation.</p>	<p>Construct proposed accommodation village to house fly in/fly out workers.</p>	<p>Workers would be accommodated without placing pressure on local housing and short stay accommodation.</p>
<p>Contracting /supply opportunities.</p>	<p>Open all contract/supply opportunities to local businesses with capacity to meet requirements.</p>	<p>Local businesses increase turnover and potentially employ more local staff Local economic growth.</p>
<p>Potential social impacts for towns with 200+ temporary construction workers; e.g. antisocial behaviour, alcohol misuse, disruption to usual town amenities.</p>	<p>Provide meals and recreational facilities at proposed construction village. Enforce worker Code of Conduct, including zero tolerance alcohol policy for the start of each shift.</p>	<p>Temporary change to amenity of towns from increased activity. Volume of workers would decrease substantially during operational phase.</p>
<p>Potential increased demand for health and emergency services, particularly during construction.</p>	<p>Provide first aid health services on-site for minor ailments and injuries. Maintain regular communication with Tumby Bay Hospital and local doctors regarding health and safety procedures and requirements.</p>	<p>Local health services may experience increased demand, particularly during a serious incident or emergency.</p>
<p>Visual impacts of operating Port for Lipson Cove campers and neighbouring farming properties.</p>	<p>Construct on-shore infrastructure on lowest part of area. Select materials and paint colours which are inoffensive. Use plantings to screen activity on Lipson Cove Road.</p>	<p>Visual impacts minimised.</p>
<p>Noise impacts for Lipson Cove campers, beachgoers and neighbouring properties.</p>	<p>Enclose machinery loading and unloading activity.</p>	<p>Some noise from heavy vehicles.</p>
<p>Potential light impacts for Lipson Cove campers.</p>	<p>Domed lights on the wharf through CEMMP and OEMMP.</p>	<p>Unlikely for light impacts</p>

A separate social and economic assessment would be required for the development application of the proposed accommodation village, so as to minimise impacts on the lifestyle and amenities of the Project's neighbouring communities at Port Neill and Tumby Bay.

Importantly, the Project's strategic location has been shown to be critical to the economic advancement of the region's mining assets. A careful and considerate approach to the development would allow Centrex to find a balance between opening up the Eyre Peninsula Region to a new and exciting industry and co-existing with other established industries, particularly agriculture and tourism.

7.4 Conclusions and Summary

Based on a qualitative risk assessment of potential environmental and social impacts the following aspects of Project operation were considered high and moderate risks:

- High Risk:
 - Marine pest import and export to and from the Project site
- Moderate Risk:
 - Greenhouse Gas
 - Marine Flora impacts – jetty
 - Marine Fauna impacts – jetty, and
 - Traffic.

It is considered that with appropriate management and monitoring measures these impacts can be reasonably managed. The appointed port operator would be required to develop suitable environmental management and incident response plans for all onshore and marine impact scenarios and comply with all environmental monitoring requirements. The potential risks associated with development of Port Spencer are considered to be commensurate with such activities and the site offers an overall low risk environmental impact option for such a facility. This site does not pose expected medium or long term negative impacts to terrestrial or marine flora or fauna species of regulatory listed conservation significance.

8.0 CONCLUSION

This Public Environmental Report (PER) is for the construction and operation of Stage 1 of the proposed private multi-user Port Spencer facility on the Eyre Peninsula. It is submitted pursuant to the provisions of section 46 of the *Development Act 1993* as a Major Development and in accordance with the requirements of the DAC (2011) *Guidelines for the Preparation of a Public Environmental Report for the Sheep Hill¹⁶ Deep Water Port Facility (Stage 1) on Eyre Peninsula*.

The proposed Port is a greenfields site located on coastal agricultural land approximately 21 km north-east of Tumby Bay and 20 km south-west of Port Neill. Centrex owns the freehold land for the purposes of the onshore Port infrastructure development and is currently in discussions with the government to secure land tenure agreements over the use of the subjacent land (seabed) and coastal strip of the proposed site. The site is characterised by disturbed historical agricultural land, remote coastal views and undulating landscapes moving inland from the coast. The Lipson Island Conservation Park is located to the south of the site and includes a small camping and visitor area.

The Port site is located within the Tumby Bay District Council Development Plan area and exists within two different zoning areas: coastal and general farming zones. The site is not located within the boundaries of any Marine Parks or aquaculture areas. This PER has reflected on requirements of both the Tumby Bay District Council Development Plan, State legislative and policy needs and overall contribution of the development to South Australian government strategic development goals. The potential environmental and social impacts are discussed in Section 6 and a risk assessment provided in Section 7.

As part of this PER the potential social, environmental and economic impacts and benefits of the Project have been considered. Management and monitoring measures to both enhance potential benefits and mitigate potential negative impacts are identified. The Project's proposed design and layout has included consideration of sustainability principles including resource and energy efficiency, through water reuse, waste management and civil construction approaches, as well as ensuring the Project makes use of existing topography and considers colour and form to ensure visual impacts are minimised to the extent practicable along the coast. As a whole it is considered this Project offers significant opportunity to contribute to not only mineral and agricultural development, but the short and long term social and economic sustainability of the region and State through direct and indirect business, infrastructure, employment and contractor opportunities as well as alignment and support of key State and regional strategic development goals. In addition the Project offers the potential benefit to support population levels and growth in rural communities and townships.

The following conclusions are made with regard to Project development overall, and general policy and strategic goals for the region and State:

- The development of this Project is a crucial transport element of Centrex's and its joint venture partners' iron ore mining strategy. Should the Project not proceed related mining developments may not be viable due to high transport costs by alternative road routes and reduced shipping capacity volumes via other smaller ports. A review of current existing port infrastructure has shown there are no other port options currently suitable to meet Centrex's shipping schedule and commercial needs.

¹⁶ The Port, formerly known as Sheep Hill, was renamed Port Spencer in late 2011.

- The Project offers a significant private financial investment of over \$AUD250 million in a private multi-user port option. This offers benefits to other local, regional and State industries looking for export capacity by sea on the Eyre Peninsula and removes the need for government spending in port infrastructure in the region.
- The Project has received wide local government and stakeholder support, with region area keen for the employment and business development opportunities, which a Port is likely to offer directly and indirectly through development of other industries that may use Port Spencer.
- Port Spencer will significantly contribute to State strategic goals relating to mineral industry infrastructure development, employment opportunities and greenhouse gas reductions.
- The proposed site does not support threatened flora or fauna and the coastal dune system at Rogers Beach would be protected by a development exclusion zone.
- The Low Open Shrubland vegetation association that is restricted to the cliff top coastal zone remains important coastal remnant vegetation given the extent of historic vegetation clearance on Eyre Peninsula. Port infrastructure has been sited to ensure no significant impact upon this vegetation association. Revegetation and other environmental management measures would be implemented to improve biodiversity values at the site. The proposed rehabilitation and revegetation of the southern aspect of the site offers a potential significant environmental benefit (SEB¹⁷) credit and opportunities to enhance degraded coastal vegetation
- The Port site would not require operational dredging and therefore many of the significant environmental marine impacts of port management would be avoided.
- Compared to other sites considered and existing ports this site offers a more suitable and low impact environmental location.
- The Project is located on a relatively remote part of the Eyre Peninsula coastline with a small camping ground associated with the Lipson Island Conservation Park south of the project. Based on air and noise assessments it is not anticipated that camp ground amenity would be disturbed by the development. There would be distinct visual changes to the coastline associated with the jetty infrastructure and shipping, however this is limited to direct viewing from the Gulf and has limited lines of sight from north and south of the site. The Project would be visible from the Lipson Island Conservation Park.
- Traffic has been considered as part of the development for access to the Port and is unlikely to have significant impacts on Lincoln Highway. Road upgrade benefits are expected for Lipson Cove Road and Swaffers Road and the intersection with Lincoln Highway would also be upgraded to allow for suitable large haul access to site. The expected traffic vehicle numbers expected to Lipson Cove Road would not negatively impact tourism use of the road.
- Public access to Rogers Beach, adjacent to the site's north, would be maintained, and the Port site would exclude Rogers Beach dunes and beach frontage from the operational footprint.

¹⁷ The clearance of native vegetation requires approval in accordance with the *NV Act* unless it is subject to an exemption under the *Native Vegetation Regulations 2003*. An offset is required for the approved removal of native vegetation and this offset is known as a significant environmental benefit (SEB).

- The design of the Project has included consideration for future expansion and upgrade potential by third parties of not only site infrastructure, but future site access rail upgrades. This creates a flexible multi-user facility that may support diverse regional industry development opportunities well into coming decades. Centrex does not require rail for mine development in the short or long term. The site layout has considered rail in line with good engineering practice and providing flexible infrastructure options for possible future users.
- The Project is considered to be of significant strategic and economic value to not only Centrex but other mineral, grain and export industries on the Eyre Peninsula. The Project offers potential economic and employment opportunities to local communities as well as regional and State contractors and businesses.

The Port location and design are such that identified environmental and social impacts can be managed without unacceptable risk to community or the environment and the Project is predominantly considered low risk. A qualitative risk assessment identified key residual risks to include:

- High risk of marine pest import and export associated with Port operation.
 - This is a risk consistent with Port operation and international vessel movement. Management and monitoring procedures would be put in place to meet Federal and State regulatory requirements.
- Moderate risk of marine flora and fauna impacts, around the Project area.
 - Impacts are expected to occur due to construction piling and associated activities and jetty shading during operations.
 - There were no habitats or species of conservation significance identified as being present within the Project area and impacts are expected to be limited in geographical extent and scale.
- Moderate risk associated with GHG emissions, which are expected due to the energy requirements for both shipping and unloading/loading options at the Port.
 - In contrast Port Spencer offers a lower GHG overseas export transport option than use of other existing road and port facilities in Northern Territory or South Australia.
- Traffic movement is considered a moderate risk due to the nature of potential safety consequences associated with vehicle movements.
 - Suitable road design elements are proposed within this PER and will be finalised in discussion with DPTI and local councils.

Port Spencer is consistent with planning and regulatory requirements and should be granted development consent.

9.0 GLOSSARY OF TERMS

Abbreviations, Acronyms and Technical Terms	Definition
\$AUD	Australian dollar
%	Percent
[A]	Meaning the Health-based Investigation Levels (NEPC, 1999) for soil in a standard residential setting where the threshold concentrations are set by regulators and assess a contaminant's potential to harm human health.
[D]	Meaning the Health-based Investigation Levels (NEPC, 1999) for soil in a residential setting with minimum opportunities for soil access where the threshold concentrations are set by regulators and assess a contaminant's potential to harm human health.
[F]	Meaning the Health-based Investigation Levels (NEPC, 1999) for soil in a commercial/industrial setting where the threshold concentrations are set by regulators and assess a contaminant's potential to harm human health.
<	Less than
>	Greater than
$\mu\text{g}/\text{m}^3$	Micrograms per cubic metre
μPa	Micro Pascals
$^{\circ}\text{C}$	Degrees Celsius
AARD	Aboriginal Affairs and Reconciliation Division
ABARE	Australian Bureau of Agricultural and Resource Economics
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
acid sulphate soils	Soils and sediments containing iron sulphides, which when exposed to air due to drainage or disturbance, produce sulphuric acid, often releasing iron, aluminium and heavy metals.
accretion rate	The rate of increase in size or extent.
AHD	Australian Height Datum
ALARP	As Low As Reasonably Practicable; relevant to risk levels considered.
annum	year
ANZECC	Australian and New Zealand Environment and Conservation Council
AQIS	Australian Quarantine and Inspection Service
AQMP	Air Quality Management Plan
ARI	Annual recurrence intervals: The interval of time between events.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASD	Approach Sight Distance
ASRIS	Australian Soil Resource Information System
Assessment Report	A report published in response to the Public Environmental Report (this report) and Response Document. The Minister for Urban Development and Planning with assistance of the Department of Planning, Transport and Infrastructure will publish the Assessment Report.
AWS	Automatic weather station
BATEA	Best available technology economically achievable
BDBSA	South Australian Department of Heritage Biological Database of South Australia

Abbreviations, Acronyms and Technical Terms	Definition
beneficiation	Processing ore to separate it from waste products
benthic	The ecological region at the lowest level of a body of water.
berth stand	The location on the jetty where ships would parallel dock in preparation for loading iron ore or grain.
BIF	Banded iron formation found in iron-rich rocks.
biofouling	Accumulation of marine biota on submerged infrastructure, including boat hulls.
biota	Animal or plant life in a defined location.
BMP	best management practice
BOM	Bureau of Meteorology
BSL	below sea level
BTEX	Benzene, toluene, ethylbenzenes and xylene
Cape class vessel	165,000 to 200,000 tonne capacity ship.
CEMMP	Construction Environmental Management and Monitoring Plan
Centrex	Centrex Metals Ltd: Port Spencer Stage 1 proponent
child dependency ratio	A fraction of the dependency ratio consisting of those too young to work.
cm	Centimetre
CO	Carbon monoxide
conveyors (main or trunk)	The apparatus that transports the iron ore or grain from on-shore storage locations to the cargo holds of berthed ships.
Coriolis effect	The deflection of a moving object due to a force experienced due to the rotation of the Earth.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAC	South Australian Development Assessment Commission
dB	Decibel: A unit of noise measurement.
dB(A)	Decibel (A- weighted) relates to the measurement of sound pressure level and is commonly used in environmental noise measurement.
DC	District Council
deep water port	For the purposes of this Public Environmental Report, a Port capable of receiving Cape class vessels with a minimum 20 m depth of water.
DEH	Department for Environment and Heritage, now known as Department of Environment and Natural Resources.
DEM	Digital elevation model: Provides a graphic representation of a surfaces elevation usually being the sea bed or land
DENR	Department of Environment and Natural Resources, formerly known as Department for Environment and Heritage.
dependency ratio	A portion of the population that is dependent, being too young or too old to work.
DfW	Department for Water, formerly the Department for Water Land Biodiversity and Conservation (DWLBC).
district	The land area within the District Council of Tumby Bay.
DMITRE	Department of Department for Manufacturing, Innovation, Trade, Resources and Energy
DPC	Department of the Premier and Cabinet
DPLG	Department of Planning and Local Government, which includes the South Australian Development Assessment Commission (DAC).

Abbreviations, Acronyms and Technical Terms	Definition
DPTI	Department of Planning, Transport and Infrastructure
draft	In relation to shipping, the draft is the distance between the waterline and the bottom of a ship's hull.
dredge	Defined by the <i>Environment Protection Act 1993</i> , dredging is the removal of solid matter from the bed of any marine waters or inland waters by any digging or suction apparatus, but excluding works carried out for the establishment of a visual aid to navigation and any lawful fishing or recreational activity.
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
DSO	Direct shipping ore: Mineral-rich rock that does not require any processing prior to export.
DTEI	Department of Transport, Energy and Infrastructure, now known as Department of Planning, Transport and Infrastructure (DPTI).
DWLBC	Department for Water Land Biodiversity and Conservation, now known as the Department for Water (DfW).
DWT	Deadweight
eddies	Small currents in a sea or ocean with a whirling motion.
EEP	Energy Efficiency Plan
EIL	Ecological Investigation Levels; Threshold concentrations set by regulators to assess a contaminant's potential to harm ecological receptors.
elderly dependency ratio	A fraction of the dependency ratio consisting of those too old to work.
ElectraNet	ElectraNet is the principal Transmission Network Service Provider (TNSP) and System Control Centre Operator in South Australia.
EMP	Environmental Management Plan
EPA	Environment Protection Authority South Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPCDS	Eyre Peninsula Coastal Development Strategy 2007
EPLGA	Eyre Peninsula Local Government Association
EPNP	Environmental Protection (Noise) Policy 2007
EPNRMB	Eyre Peninsula Natural Resource Management Board
EPP(WQ)	Environment Protection (Water Quality) Policy 2003
ERDB	Eyre Regional Development Board, now known as Regional Development Australia – Whyalla and Eyre Peninsula Inc (RDAW&EP)
EVAO	Estimated value of agricultural operations
EYB-3	Eyre Hills: A location within the Eyre region.
Eyre region	Referred to as the Eyre region in general. This encompasses the Statistical Local Areas (SLAs) of Ceduna, Cleve, Elliston, Franklin Harbour, Kimba, Le Hunte, Lower Eyre Peninsula, Port Lincoln, Streaky Bay and Tumby Bay. The Eyre region covers an area of approximately 55,000 km ² and in 2006 had a population of 33,342.
Fe	Iron
Fe ₂ O ₃	Hematite (iron oxide)
Fe ₃ O ₄	Magnetite (iron oxide)
Freehold land	Land held in fee simple
GHG	Greenhouse gas

Abbreviations, Acronyms and Technical Terms	Definition
GIS	Geographic Information System
GLC	Ground level concentrations
Guidelines	<i>Guidelines for the Preparation of a Public Environmental Report for the Sheep Hill Deep Water Port Facility (Stage 1) on Eyre Peninsula</i> , Development Assessment Commission, Department of Planning and Local Government, Government of South Australia, Adelaide.
GVP	Gross value of agricultural production
GW	Groundwater
ha	Hectare (10,000 m ²)
hematite	Iron ore (Fe ₂ O ₃) usually exported as rock with Fe > 30% and directly shipped.
HIL	Health-based Investigation Levels; Threshold concentrations set by regulators to assess a contaminant's potential to harm human health.
h	Hour
Hydrologic analysis	In relation to water flows, the establishment of peak flows and occurrences.
Hz	Hertz
IBRA	Interim Biogeographic Regionalisation for Australia
intertidal zone	The shore area above water at low tide and under water at high tide.
ISA	Immediate Study Area
ISO	International Standards Organisation
isobath	Contour lines on the seafloor
ISQG-Low	Low trigger values of the Interim Sediment Quality Guidelines (ANZECC, 2000).
IUCN	International Union for Conservation of Nature
kHz	Kilohertz, meaning 1,000 hertz.
kL	Kilolitre, meaning 1,000 litres.
km	Kilometre, meaning 1,000 metres.
km/h	Kilometres per hour
Km ²	Kilometres square
KOV	Key Observation Viewpoints
kt CO ₂ -e	Kilo-tonne carbon dioxide equivalence: Refers to a quantity that describes a given mixture and amount of greenhouse gas that would have the same global warming potential when measured over a specified amount of time.
L	Litre
L/h	Litre per hour
L/kWh	Litre per kilowatt hour
L _{A90}	Logarithmic average of noise levels exceeded for 90% of the sample time.
L _{A90, 15 min}	Logarithmic average of noise readings taken every 15 minutes continuously over 7 days.
LAT	Lowest astronomical tide
Lipson Island	Lies off the coast of South Australia near Tumby Bay and is approximately 1 hectare in size.
Lipson Island Conservation Park	Refers to the Lipson Island Conservation Park on Lipson Island and is managed by the South Australian Department of Environment and Natural Resources (DENR).

Abbreviations, Acronyms and Technical Terms	Definition
LOR	Limit of reporting: Usually arises in the context of laboratory analysis during an environmental investigation and sets levels that require reporting to government authorities, usually the EPA.
m	Metre
m/s	Metres per second
m/y	Metre per year
m ²	Square metre
m ³ /s	Cubic metres per second
magnetite	Iron ore (Fe ₃ O ₄) usually sold as pellets.
major development	A major development within the definition of section 46 of the <i>Development Act 1993 (SA)</i>
mg	Milligram, meaning one one-thousandth of a gram
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
Micrometre	One millionth of a metre
ML	Megalitre, meaning one million litres
ML/day	Megalitre per day
mm	Millimetre
mm/y	Millimetre per year
MSIC	Maritime Security Identification Card
Mt	Million tonnes
mtpa	Million tonnes per annum
MW	Megawatt
N	North
NAGD	National Assessment Guidelines for Dredging
ng	Nano gram, meaning one billionth of a gram
National environmental significance	As defined within the meaning of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and includes; world heitrage properties, national heritage places, wetlands of international importance, listed threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park and nuclear actions (including uranium mines).
NEPM	National Environment Protection Measure. NEPM's are broad statutory instruments defined in the <i>National Environment Protection Council Act 1994</i> , which allow for uniform assessment of site contamination across Australia.
ng/L	Nano grams per litre
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NO _x	oxides of nitrogen
NPW Act	<i>National Parks and Wildlife Act 1972</i>
NRM Act	<i>Natural Resources Management Act 2004</i>
NVC	Native Vegetation Council
OCP	Organochloride pesticides
OEMMP	Operational Environmental Management and Monitoring Plan
offset	A balancing or compensation measure
OPP	Organophosphate pesticides

Abbreviations, Acronyms and Technical Terms	Definition
ore	A type of rock that contains minerals such as metals
PAH	Polycyclic aromatic hydrocarbons
Panamax class vessel	65,000 to 90,000 tonne capacity shipping vessel.
payload	The load a vehicle or vessel is designed to transport
PCB	Polychlorinated biphenyls
peak flow rain event	The maximum amount of water that would result from a certain design level storm.
PER	Public Environmental Report. A Public Environmental Report describes the Project in detail and evaluates social, environmental and economic effects of the construction and operation of the Project as required under the Development Assessment Commission's <i>Guidelines for the Preparation of a Public Environmental Report for the Sheep Hill Deep Water Port Facility (Stage 1) on Eyre Peninsula</i> (2011).
pers. comms.	Personal communication
PIRSA	Department of Primary Industries and Resources of South Australia, now known as Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) for the purposes of mine approval.
Plan	<i>Strategic Infrastructure Plan for South Australia 2004/05- 2014/15</i> , Government of South Australia, South Australia
PLBC	Port Lincoln Boundary Current
PM	Particulate matter
PM ₁₀	Particulate matter 10 micrometres or less in diameter.
PM _{2.5}	Particulate matter 2.5 micrometres or less in diameter.
Port	Refers to Port Spencer, the subject of this Public Environmental Report.
ppm	Parts per million
Project	For the purposes of this Public Environmental Report the term 'Project' refers to Stage 1 development of the Port Spencer development.
Project area	The area as defined encompassing proposed Stage 1 infrastructure development of Port Spencer (formerly known as Sheep Hill Port) which approximately 48 hectares in size. The total site footprint is estimated to be 140 hectares.
Project Updates	Public newsletters published by Centrex.
psu	Practical salinity units
Q	Quarter of the relevant year
quadrat	Defined area of land used for ecological surveys
RAV	Restricted access vehicle
RDAW&YP	Regional Development Australia – Whyalla and Eyre Peninsula Incorporated
Response Document	Is a document that will be drafted by Centrex in response to public or agency comments regarding this Public Environmental Report.
RMS	Root mean square
s	Second
S	South
SA	South Australia
SAM	South Australian Museum
SARDI	South Australian Research and Development Institute

Abbreviations, Acronyms and Technical Terms	Definition
SASP	South Australia's Strategic Plan 2011
SD	Statistical Division
SA Water	South Australian Water Corporation
SEB	Significant Environmental Benefit
SEDMP	Soil Erosion and Drainage Management Plan
SEL	Cumulative sound exposure level
SES	State Emergency Service
SISD	Safe Intersection Sight Distance
SLA	Statistical Local Area
SLM	Sound Level Monitoring
Sodosols	Soils with strong texture contrast between the surface layer and sodic subsurface layer. Sodic solids hold sufficient sodium to be used for plants, including crops.
SO _x	Oxides of sulphur
SPL	Sound pressure level
Stage 1	Stage 1 refers to the proposed first stage of Port Spencer development. Stage 1 is the subject of this Public Environmental Report.
Stage 2	Stage 2 refers to the proposed second stage of development of Port Spencer. It is proposed this would include magnetite development (construction of; magnetite storage area and dewatering plant, magnetite import from proposed mines via underground slurry pipelines) and a desalination plant, if required.
Stage 3 and 4	Stage 3 and 4 refer to the proposed third and fourth stage of development of Port Spencer. It is proposed this would include expansion of magnetite storage and processing, one extra hematite storage shed and one extra and grain storage shed.
Stakeholder Response Report	The Centrex 2011 Stakeholder Response Report which provides public feedback on questions raised during the 2011 public consultation period.
subtidal	The shore area only exposed in extremely low tides.
supratidal zone	The shore area immediately above the high tide zone.
SWMP	Surface Water Management Plan
t	Tonne, equivalent to 1,000 kilograms
t/h	Tonnes per hour
TBC	To be confirmed
TDS	Total dissolved solids
Tenosols	Soils with generally weak vertical soil profile, except in the surface layer.
TPH	Total petroleum hydrocarbons
Transect survey	A pathway taken where occurrences of the study subject are observed and counted.
TSP	Total suspended particulate
VHOC	Volatile halogenated organic compounds
viewshed analysis	Determination of the visibility of an area from a certain location using GIS software.
Village	Refers to the construction village
Vortices	Spinning and often turbulent flow of liquid.
Vpd	Vehicles per day
VSA	Visual amenity study area

Abbreviations, Acronyms and Technical Terms	Definition
Waste Fill	Defined by the <i>Environment Protection Regulations 2009</i> as soil that can be disposed of to landfill without incurring a waste levy and can consist of; clay, concrete, rock, sand, soil or other inert mineralogical matter in pieces not exceeding 100 millimetres in length and having specified chemical concentrations less than those defined in Schedule 6 of the Regulations.
WISCO	Wuhan Iron and Steel Company
WMP	Waste Management Plan
WoNS	Weed of National Significance
WSUD	Water Sensitive Urban Design

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