PENINSULA PORTS

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Port Spencer Grain Export Facility

Amendment to Public Environmental Report

VOLUME 3 OF 5

IW219900-0-RPT-0003 | 1

November 2019

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Appendix A. Surface Water Technical Note

JACOBS

Memorandum

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Subject	**Surface Water Technical Note**	**Project Name**	Port Spencer Grain Export Facility
From	Declan Mead		
Date	October 25, 2019	**Revision**	0
Copies to			

1. Introduction

Peninsula Ports is proposing to build a wharf and grain handling facility at Port Spencer on the Eyre Peninsula. Previously in 2011 CENTREX Metals Ltd gained development approval to construct a Deep Water Marine Port at Port Spencer (the Evaluated Project), however this project was not continued. Peninsula Ports are creating an amendment to the CENTREX Public Environment Report (PER) to obtain approval for their own project (the Proposed Amendment).

A concept design for the Proposed Amendment has been created which is described and compared to the CENTREX design in the 'Review of Evaluated Project'. This technical note is an attachment to that document to describe in more detail the surface water components of the design.

This technical note details:

- the changes in hydrological data from the time of the Evaluated Project to the Proposed Amendment,
- the changes in drainage design between the two development applications (both due to the changes in hydrological data and changes in design)
- and, the methodology for this concept drainage design

2. Changes in Hydrological Data

This section discusses the changes in rainfall data and in Australian Rainfall & Runoff (AR&R) parameters from the time of the Evaluated Project to now and their effect on the surface water at the site.

2.1 Rainfall Intensity-Frequency-Duration data

Current Intensity-Frequency-Duration rainfall data for the site area obtained from the Bureau of Meteorology has decreased compared to the data at the time of the Evaluated Project. The rainfall data for storms of durations 10 minutes to 1 hour with average exceedance probabilities (AEPs) of 1% and 10%, decreased by 2-4% for 10% AEP storms and 7-15% for 1% AEP storms.

Table 1 - Changes in Rainfall Data

	Reduction in Rainfall	
	Storms Duration 10 min to 1 hr	Storm Duration 72 hr
AEP 10%	2-4%	-
AEP 1%	13-15%	7%

2.2 Storm Loss values

The changes between the AR&R recommended loss values from the time of the Evaluated Project to now is shown in Table 2 below. The losses have increased significantly. The loss values taken at the time of the Evaluated Project were from AR&R 2001 (Pilgrim 2001) which were regional values. The loss values provided in AR&R 2019 (Ball, 2019) are determined by equations developed considering soil conditions, evaporation and vegetation.

Table 2 - Changes in Losses

	AR&R 1987	AR&R 2019
Initial Loss (mm)	10	23
Continuing Loss (mm/hr)	2	2.8

The increase in losses will result in less rainfall being converted to surface runoff or 'rainfall excess'. To assess the effect of the increase in losses the rainfall excess for two storms, the 1% AEP/1hr duration and 10% AEP/1hr duration, was estimated with the losses used in the CENTREX surface water study and with the current AR&R 2019 losses.

Table 3 - Rainfall Excess for design storms with AR&R 1987 and AR&R 2019 losses

	AR&R 1987	AR&R 2019	AR&R 1987	AR&R 2019
AEP	1%		10%	
Duration	60 min		60 min	
Rainfall depth (mm)	39.5		22.7	
Median Preburst (mm)	-	6.7	-	3.8
Estimated total losses (mm)	11.5	24.6	11.1	23.4
Rainfall excess (mm)	27.5	21.6	10.7	3.1
As percentage of AR&R 1987	-	78%	-	29%

As a comparison, the rainfall excess is decreased by 22% for the 1% AEP storm with the new losses. For the 10% AEP event the rainfall excess is decreased by 71% with the new losses.

2.3 Impact of Changes

The decrease in rainfall and increase in losses will see a decrease in the flowrates and volumes at the site. There is potential for a significant decrease in the determined flows for the 10% AEP event.

3. Changes in Offsite and Onsite stormwater Management

The key principles in the stormwater management of the site remain the same from the Evaluated Project to the Proposed Amendment. These are:

- Zero discharge of the site runoff to the marine environment
- Low velocity design where possible
- Offsite runoff continues to discharge to Roger's Beach, but quantity is not increased by the project.
- Tributary flows are diverted around the site towards Roger's Beach
- Similar total impervious area to the Evaluated Project.
- Detained site runoff is to be reused on site.

This is provided in:

- Three detention basins for site stormwater runoff of a combined size of 65ML, sized to the 1% AEP event, to contain all site runoff and prevent discharge to the marine environment. This is discussed in section 4.2.
- A decrease in total catchment discharging to Roger's Beach of 7% and the construction of a 28ML flow attenuation basin on the major creek upstream of the site to reduce the 1% AEP event storm flow from 31 m^3/s to 10 m^3/s. This will reduce peak flows to Roger's Beach from pre-development levels. This is discussed in section 4.2.

Key differences between the conceptual stormwater design (shown in Figure 1) for the Evaluated Project and the Proposed Amendment are:

- The major flow path through the site still flows through the site instead of being diverted around the site. However, a portion of the flow path is shifted from its natural path.
- A decrease in site runoff extended detention storage from 136 ML to 65 ML. This is due to the decrease in catchment area that is detained from 169 ha to 61ha.These catchments are shown in Figure 2. The catchment area that is removed (95ha) is undisturbed catchment outside the project site that is diverted through the site instead of detained for the proposed amendment. The surface water catchments are shown in Figure 3.

The conceptual stormwater design to achieve the stormwater management principals is shown in Figure 1.

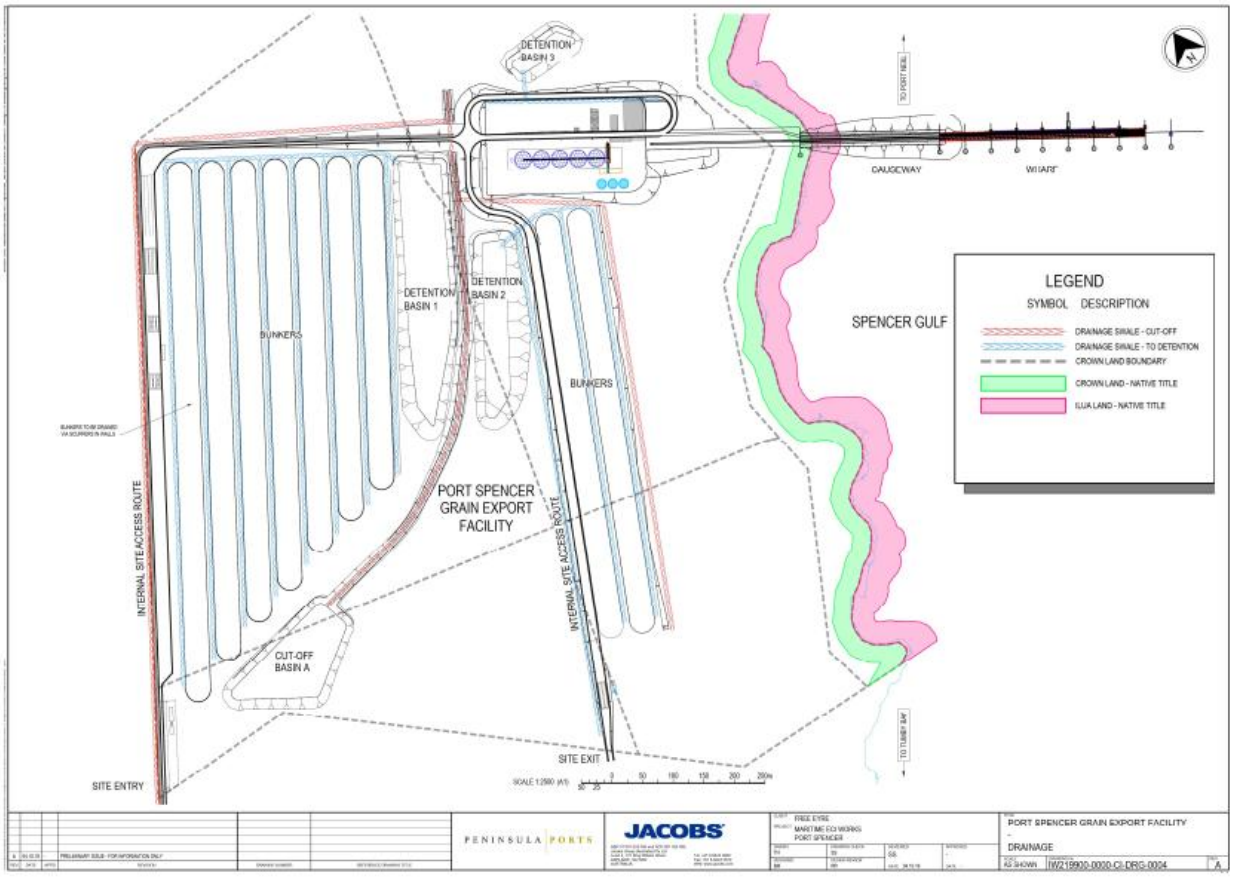

Figure 1 - Conceptual Stormwater Design

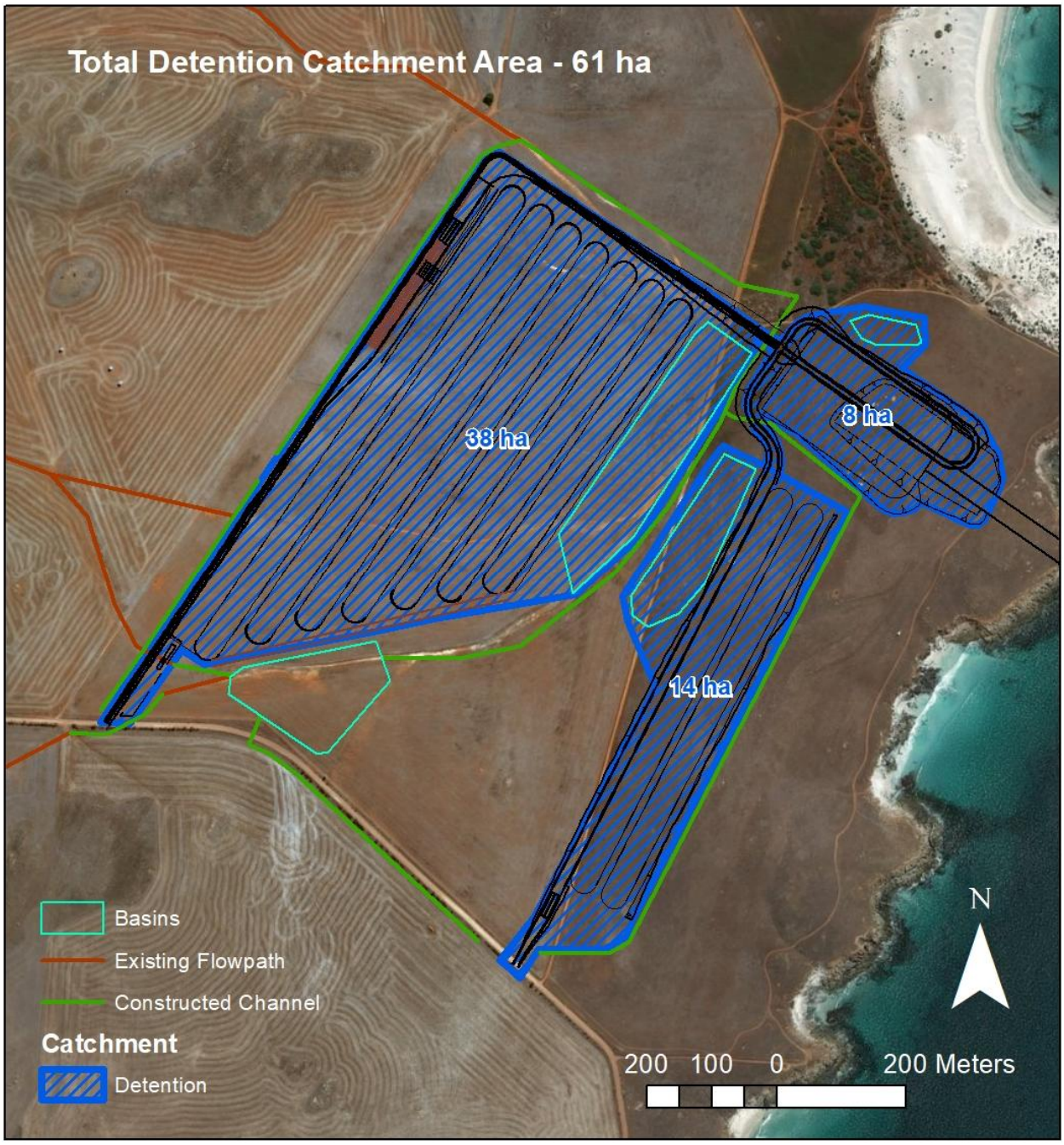

Figure 2 - Total Detention Catchment Area

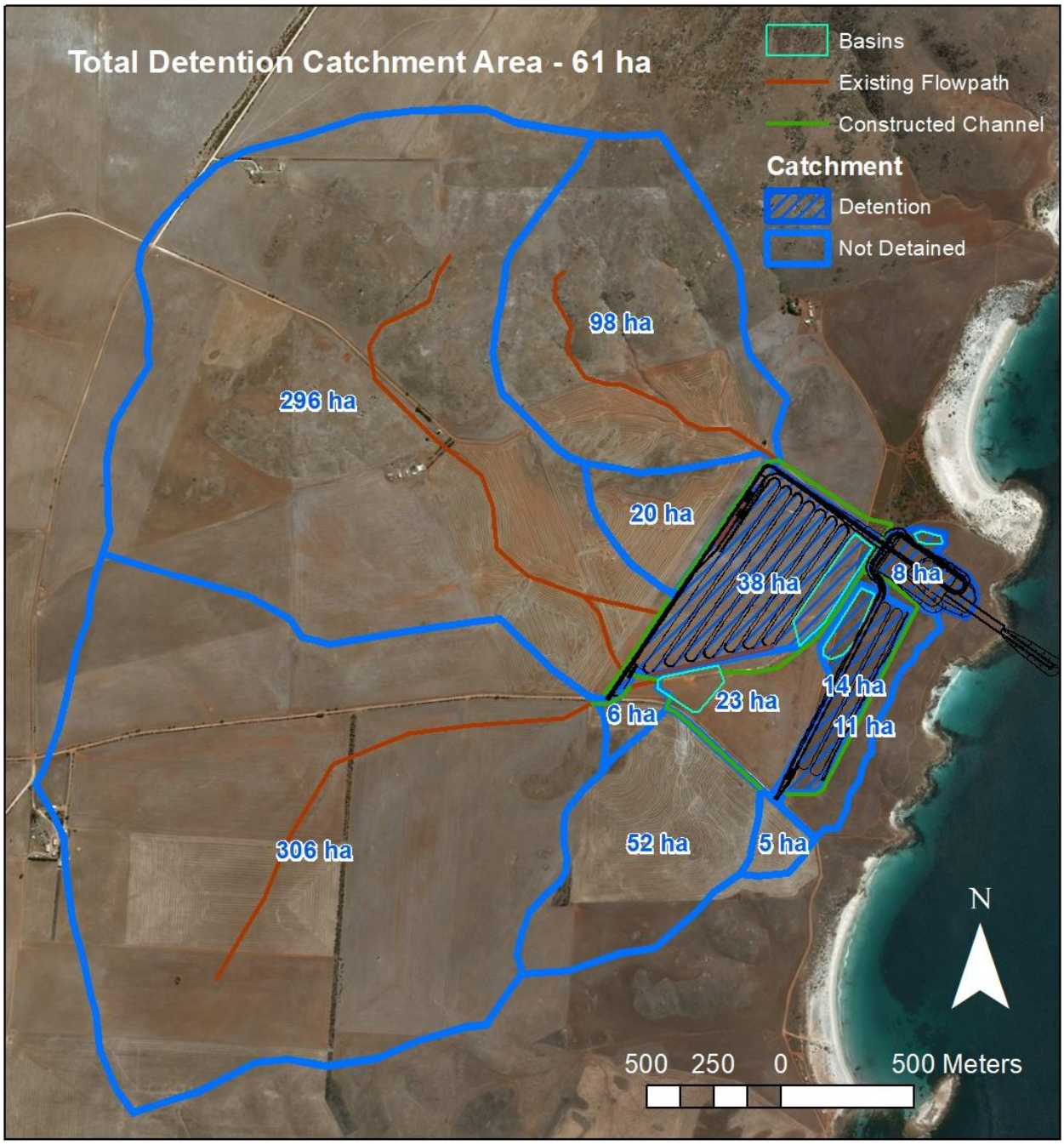

Figure 3 - Surface Water Catchments

4. Stormwater Design Methodology

4.1 Design Flows

Flows have been calculated using the rational method for the purposes of preliminary sizing of culverts and drainage channels. Ideally, the Regional Flood Frequency Estimation Model (RFFE), as part of AR&R 2019, would be used for design flow estimation as this uses the latest science in its predictions and a number of site studies around Australia. However, the RFFE was temporarily unavailable for the arid region, where the project site sits, at the time of this study.

The results of the rational method were compared to the following methods to validate its suitability:

- The results with hydrological run-off routing software XPSWMM used in the CENTREX development approval. The results from XPSWMM would be considered more accurate due to the models increased complexity which makes use of catchment data such as flow lines and their lengths and slopes.
- The XPSWMM results adjusted for the effect of increased loss values since the time of the Evaluated Project to now as detailed in section 2.2.
- The DPTI Rational Method. This is preferred by DPTI to other rational methods for rural catchments <5km^2
- The RFFE model estimates for other regions than the arid region.

This comparison is shown in Table 4.

Table 4 - Comparison of Design Flow Estimation Methods

Method		AR&R 2019 RFFE - Area on West Coast of Yorke Peninsula with similar rainfall intensities	AR&R 2019 RFFE - Adelaide Hills	Rational Method	XPSWMM – Adjusted for 2019 loss values	XPSWMM	DPTI Rational Method
Catchment = 9.09km^2 Q100	With 2011 rainfall data			41	53 (subtract 22% for decrease in rainfall excess)	68	75.1
	With 2019 rainfall data	0.45 (90% CI = 0.1-1.6)	8.43 (90% CI = 2.3-30)	29.9			54.4
Catchment = 3.1km^2 Q100	With 2019 rainfall data	0.11 (90% CI = 0.03-0.36)		18.9			33.5

For the same catchment, using the same available data, for the 1% AEP 1hr event the XPSWMM model estimates a flow of 68m^3/s whereas the rational method estimates a flow of 41m^3/s. However, with the increase in losses, the two methods will become more comparable. Greater losses will be reflected in the XPSWMM decreasing the flow by 22% (rainfall excess reduced to 78%).

The DPTI rational method gives much higher flow estimates than all other methods.

The most recently developed estimation method, the RFFE model, gives much smaller estimates for both similar regions (Yorke Peninsula) and much wetter regions that would have higher expected design flows (Adelaide Hills).

Hence, the rational method is a suitable middle ground estimate between the more complex XPSWMM runoff-routing model and the recent AR&R 2019 RFFE model predictions that is suitable for concept level design.

4.2 Design Volumes

Volumes have been calculated for the purposes of sizing basins.

Detention Basins

Three detention basins have been designed to capture all site runoff. The sizes have been determined by calculated the volume of runoff from a 1% AEP storm. This volume has been calculated using:

- The site catchment areas , this includes all impervious areas and all surrounding undisturbed areas that would flow into the site area and site drainage. This is split into three catchments of 38,14 and 8 ha that drain to each basin.
- Trialing 1% AEP storm events of a range of durations, typically 1-3 days and total rainfall depth of 104-123mm
- Impervious fractions of 80%-90%
- Assuming all rainfall is converted to runoff for the impervious areas
- Calculating the median rainfall excess from the pervious areas using initial and continuing losses of 23mm and 2.8mm/hr and the 10 temporal patterns from AR&R 2019.
- Allowing a freeboard of 300 mm

This gives a required storage of 41ML, 15 ML and 9 ML, making a total of 65ML. This is significantly smaller than the Evaluated Project which allowed for 136ML of storage because that design had a much greater catchment, 169ha, due to a catchment outside the project site draining to the site drainage.

The two detention basins are located either side of the existing drainage path flowing through the site so that site drainage does not enter that drainage path.

Attenuation Basin

An attenuation basin has been designed to sit in the existing creek bed upstream of project infrastructure to attenuate the flows through the site and decrease flow widths. The attenuation basin has been sized

using the procedure in Austroads Guide to Road Design Part 5A. 28ML storage is required to attenuate a 31 m^3/s 1% AEP flow to 10m^3/s with allowance for 300 mm freeboard.

References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) *Australian Rainfall and Runoff: A Guide to Flood Estimation*, © Commonwealth of Australia (Geoscience Australia), 2019.

Pilgrim, DH, (ed). (2001). Au*stralian Rainfall & Runoff – A Guide to Flood Estimation, Revised Edition* Institution of Engineers, Australia, Barton, ACT.

Appendix B. Traffic Impact Assessment

Port Spencer

Peninsula Ports

Port Spencer - Traffic Impact Assessment

IW162800-CT-RPT-0001 | 0

8 November 2019

Document history and status

Revision	Date	Description	By	Review	Approved
0	8/11/2019	Final	M Heintze	B Champion	S Snedden

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
0		8/11/2019	DPTI	Final

Port Spencer

Project No:	IW162800
Document Title:	Port Spencer - Traffic Impact Assessment
Document No.:	IW162800-CT-RPT-0001
Revision:	0
Date:	8 November 2019
Client Name:	Peninsula Ports
Client No:	
Project Manager:	Scott Snedden
Author:	Melisse Heintze
File Name:	J:\IE\Projects\06_Central West\IW219900\21 Deliverables\Traffic Impact\IW162800-CT-RPT-0001 - Port Spencer TIA_Rev 0.docx

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Executive Summary

Jacobs have been engaged by Free Eyre to undertake a Traffic Impact Assessment suitable to inform the development application planned for Port Spencer – a new deep water port and grain handling and export facility – located near Lipson Cove along the Eyre Peninsula's eastern coastline.

Previous PER

In 2011, Centrex Metals Limited had proposed to construct a deep water shipping port to operate as a multi-commodity export terminal at this location, to be capable of:

- Accommodating Panamax (65,000 – 90,000 tonne capacity) and Cape class (165,000 – 200,000 tonne capacity) vessels
- Exporting up to 20 million tonnes of ore per annum from a single berth configuration and single ship loader, with the potential to serve as a multi-use export gate for grain and other bulk minerals in the Eyre Peninsula region.

At the time, Free Eyre Limited (FEL) was the preferred grain supplier and was closely involved in the planning for the project. Port Spencer Stage 1 Project (the Evaluated Project) successfully received Provisional Development Plan consent to export both iron ore and grain from the site.

The provisional development authorisation granted to Centrex Metals in 2012 and extended in 2014 currently remains active and was transferred to Peninsula Ports (a subsidiary of FEL) in mid-2019 following purchase of the land from Centrex Metals. Peninsula Ports is currently seeking to amend the existing Development Plan consent under Section 47 of the *Development Act 1993*.

Current Revised PER

The current proposal for Port Spencer considers a deep water port and grain handling and export facility, to be capable of:

- 880,000 tonne grain storage
- Exporting 1,000,000 tonne of grain per annum via a new export port
- Accommodating Panamax vessels
- Handling up to 30,000 tonne peak receivals per day

Once Port Spencer is completed and fully operational, it has the potential to support the grain exportation of almost a third of the peak historic Eyre Peninsula production.

Traffic Impacts

To assess the potential impact to the operation of the existing road network as a result of both the construction of the development and operation of the development, the total generated traffic has been divided into three categories:

- **Light Vehicle traffic** (e.g. 4WDs and cars) associated with staff movements to and from the site.
- **Heavy Commercial Vehicles** (e.g. >2-tonne trucks, semi-trailers, dump trucks etc.) associated with deliveries to site during construction and operation that will travel on roads according to the current gazettal's.
- **Over Dimensional and Over Mass Vehicles** associated with transportation of construction materials to site that may only travel under NHVR and DPTI permit.

<u>Operation Impact</u>

Numerous scenarios have been considered to help assess the operation impact of the development, noting several significant changes have recently occurred within the wider Eyre Peninsula road network:

- Closure of railway line in June 2019, which has resulted in significant increases of freight vehicles on the road network transporting grain to existing export ports (predominately to Port Lincoln)
- New export port at Lucky Bay expected to receive first harvest revivals for the 2019/2020 harvest season.
- Viterra plans to close six silo sites on the Eyre Peninsula (that being Minnipa, Kyancutta, Cungena, Waddikee, Kielpa and Wharminda) prior to the 2019/20 harvest season.

The impact of these recent changes to the grain storage and handling across the Eyre Peninsula during a harvest season is not yet understood but is thought to have a significant impact on the existing road freight network. This assessment has made several assumptions of the impact resulting from these recent changes, to better understand the new baseline transport situation and the impact in conjunction with the proposed Port Spencer.

The assumed impact that could be directly attributed to the Port Spencer development will primarily occur during the seasonal grain harvest period, when the site is expected to receive up to 1 million tonnes of grain per annum (assumed to be within an eight week period between October and December).

Although the estimated increase in freight volumes converging to Lincoln Highway and Lipson Cove Road of up to 980 total two-way movements at the Lincoln Highway / Lipson Cove Road intersection (or up to 860 two-way CV movements) per day during the seasonal peak harvest period, the roads will still operate under capacity. Upgrades to the road network are proposed to improve safety on the surrounding road network during site operations, noting the large number of heavy vehicles attracted to Port Spencer.

Construction Impact

Construction of the proposed Port Spencer site is assumed to be undertaken over a 12 – 13 month period. The number of two-way trips during the assumed peak construction periods (Month 2 = peak construction material delivery period, and Months 10 – 11 = peak construction workforce period) is estimated in the following table.

	Lipson Cove Road		Lincoln Highway	
	During Peak Construction Material Delivery Period (Month 2)	During Peak Construction Workforce Period (Months 10 – 11)	During Peak Construction Material Delivery Period (Month 2)	During Peak Construction Workforce Period (Months 10 – 11)
Traffic Volume	50 Annual Average Daily Traffic (AADT)		934 AADT *	
HCV Volume	5 AADT (10.0% of total)		234 AADT (25.1% of total) *	
Generated Traffic	93 trips/day	154 trips/day	93 trips/day	154 trips/day
Generated HCVs (including OD Vehicles)	25 trips/day	5 trips/day	25 trips/day	5 trips/day
TOTAL Traffic	143 trips/day	204 trips/day	1,027 trips/day	1,088 trips/day
TOTAL HCVs	30 trips/day (21.0%)	10 trips/day (4.9%)	259 trips/day (25.2%)	239 trips/day (22.0%)
Traffic Increase	+186%	+308%	+10.0%	+16.5%
HCV Increase	+500%	+100%	+10.7%	+2.1%

* *New Baseline Transport Situation* link volume considered between Wharminda Road and Ungarra Road

From a traffic capacity viewpoint, the peak construction traffic impact of the proposal is considered to be minimal.

Findings and Recommendations

Based on the traffic assessment undertaken for this development, road upgrades are not required from a capacity viewpoint, however a number of turning treatments and other road improvements to improve road safety should be considered should the development be approved, as listed following:

- New Intersections:
  - **Entry Access Point (T1):** Basic left turn treatment from major road (Lipson Cove Road).
  - **Exit Access Point (T2):** Basic right turn treatment from minor road (site access road).
- Intersection Upgrades:
  - **Lipson Cove Road / Lincoln Highway intersection:** Full channelised turn treatment. Channelised right turn treatment form major road (Lincoln Highway) to be provided to allow for two queued Road Trains. Channelised left turn treatment from major road (Lincoln Highway) to be provided. Channelised left turn treatment from minor road (Lipson Cove Road) to merge into a add lane on Lincoln Highway exit to allow for slow moving vehicles to come up to speed.
- Road Upgrades:
  - **Lipson Cove Road:** Between Lincoln Highway and 50 m beyond Exit Access Point (T2), provide full sealed pavement (noting increased heavy vehicle loading) (also benefit in dust suppression) and localised vegetation trimming (to improve sight lines). Maintain existing priority controls for junction with South Coast Road (located along road section).

Further discussion would be undertaken with the Department of Planning, Transport and Infrastructure and Council to reach agreement on the detailed design of the recommended road network improvements, should the development proceed.

Road network improvements beyond those recommended above may be required, but cannot be solely attributed to this proposed development due to the numerous other recent changes across the wider Eyre Peninsula region.

Of particular interest are the east-west movements across one or a combination of the Bratten Way and several other unsealed Council roads connecting the Tod and Lincoln Highways. In consultation with the Technical Working Group of the Eyre Peninsula Local Government Association convened by Peninsula Ports, concerns have been raised about the impact on the local roads and a strong preference for a new, strategic, sealed east-west route has been expressed.

Due to the unknowns surrounding future driver behaviour and changes in the east-west grain commodity route transport preferences, it is recommended that the unsealed Council roads between Tod Highway and Lincoln Highway be monitored for future east-west freight volume increases during the seasonal harvest period to inform any new future strategic east-west freight link upgrades, as recommended in the Eyre Peninsula *2019 Regional Transport Strategy* (SMEC, 2019).

1. Introduction

1.1 Background

Jacobs have been engaged by Free Eyre to undertake a Traffic Impact Assessment suitable to inform the development application planned for Port Spencer – a new deep water port and grain handling and export facility – located near Lipson Cove along the Eyre Peninsula's eastern coastline.

1.2 Previous Development Application

In 2011, Centrex Metals Limited had proposed to construct a deep water shipping port to operate as a multi-commodity export terminal at this location (note that this site has also been previously referred to as Sheep Hill Port), to be capable of:

- Accommodating Panamax (65,000 – 90,000 tonne capacity) and Cape class (165,000 – 200,000 tonne capacity) vessels
- Exporting up to 20 million tonnes of ore per annum from a single berth configuration and single ship loader, with the potential to serve as a multi-use export gate for grain and other bulk minerals in the Eyre Peninsula region.

The project also considered a road transport and infrastructure access corridor that generally followed the alignment of the existing ungazetted Swaffers Road from Lincoln Highway.

The project was gazetted as a Major Project by the State Government in January 2011, and the development application for Stage 1 of the port was later granted provisional development authorisation by the Governor in 2012 (with the Minister of Planning granted delegate powers).

The Project was proposed to be developed in four stages:

- Stage 1 was to be constructed to allow the export of hematite and grain.
- Stages 2 - 4 were to allow for export of magnetite and be subject to further development approvals.

Stage 2 was to 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 were to include expansion of magnetite storage and addition of extra hematite and grain storage facilities.

At the time, Free Eyre Limited (FEL) was the preferred grain supplier and was closely involved in the planning for the project. Port Spencer Stage 1 Project (the Evaluated Project) successfully received Provisional Development Plan consent to export both iron ore and grain from the site.

The provisional development authorisation granted to Centrex Metals in 2012 and extended in 2014 currently remains active and was transferred to Peninsula Ports (a subsidiary of FEL) in mid-2019 following purchase of the land from Centrex Metals. Peninsula Ports is currently seeking to amend the existing Development Plan consent under Section 47 of the *Development Act 1993.*

1.3 This document

This technical report outlines a Traffic Impact Assessment (TIA) prepared to identify the transport changes between the previous proposed development and the new development.

This TIA reports Jacobs understanding of the traffic and transport impacts of operational and construction traffic to the Port Spencer development site. This report includes Jacobs' observations concerning transportation requirements of the generated traffic including over-dimensional components from the Lincoln Highway to the first place of rest at the project site and is intended to identify a preferred transportation route for over-dimensional components.

The TIA is an expression of the professional opinion of Jacobs, based upon design details that were available at the time of assessment. It is not a final conclusion and should only be taken as a guideline in terms of consideration for actual transport setup and route to be used, and/or modifications to be done.

This TIA is based on observations made during a site visit on Wednesday 4th September 2019. All parties should be aware that road conditions could change anytime between the date of route observations and the project execution, for reasons including adverse weather, road modifications/repairs by authorities and general deterioration.

1.4 Other related documentation

This report should be read in conjunction with the documents detailed in Table 1.

Table 1: Related documentation

Type	Title	Description	Author	Date of Issue
Report	*Port Spencer – Traffic Impact Assessment*	*Updated TIA for Port Spencer*	*Jacobs*	*This report*
Report	Centrex Metals – Port Spencer, Eyre Peninsula – Traffic Impact Assessment	Previous TIA (submitted as Appendix H in the previous Development Application for Centrex Metals)	MFY	22 September 2011
Report	Eyre Peninsula Freight Study	EP Freight Study prepared for The Department of Planning, Transport and Infrastructure and Genesee and Wyoming Australia. Primary focus on the future use of the existing rail network.	SMEC	26 September 2019 (Rev 0 issued as Final)
Report	2019 Regional Transport Strategy	Regional Transport Strategy prepared for the Eyre Peninsula Local Government Association (EP LGA)	SMEC	1 August 2019 (Rev 0 issued as draft to EP LGA)

2. Proposed Development

2.1 Description of On-site Development

The proposed Port Spencer is located on the Spencer Gulf in the District Council of Tumby Bay, approximately 70 km north-east of Port Lincoln and 20 km north-east of Tumby Bay.

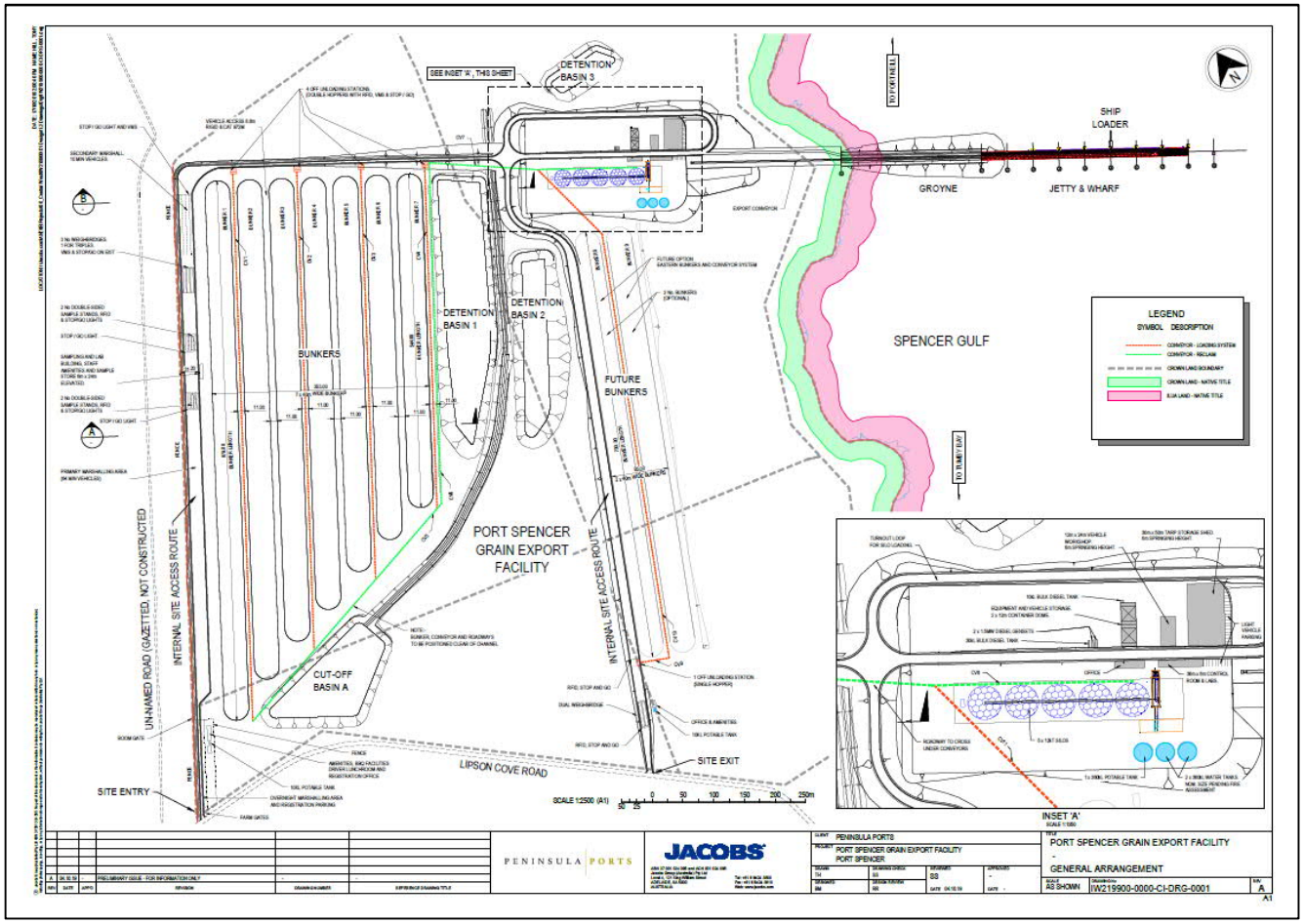

Figure 1: Proposed Port Spencer facility

Port Spencer is a deep water port and grain handling and export facility, to be capable of:

- 880,000 tonne grain storage
- Exporting 1,000,000 tonne of grain per annum via a new export port
- Accommodating Panamax vessels
- Handling up to 30,000 tonne peak receivals per day

Once Port Spencer is completed and fully operational, it has the potential to support the grain exportation of almost a third of the peak historic Eyre Peninsula production.

2.2 Comparison of the development to previous approved development application

Table 2 below summaries the key transport differences between the previous approved development application, and the new proposed Port Spencer facility.

Table 2: Comparison of the development to previous approved development application

	Previous approved development application	New proposed Port Spencer facility
Stages of development	*4 (Stage 1 considered by approved application only)*	Up to 2 stages
Export of	*Bulk minerals and grain*	Grain
Export volume per annum	*1 million tonne of grain* *2 million tonnes of hematite*	1 million tonne of grain
On-site storage	*60,000 tonne grain storage* *Bulk minerals storage – not defined*	880,000 tonne grain storage
Vessel size	*Vessels up to Cape class*	Vessels up to Panamax
Road upgrade recommendations	*Swaffers Road / Lincoln Highway junction* *Lipson Cove Road / Lincoln Highway junction* *Swaffers Road (heavy vehicle route)* *Lipson Cove Road (light vehicle route)*	Lipson Cove Road / Lincoln Highway junction Lipson Cove Road (heavy & light vehicle route)
Freight vehicle size	*Road Train = 80% (79 tonne)* *B-Double combinations = 20% (45 tonnes)*	*70 tonne freight vehicles – Considered to be representative of an average freight fleet of:* • *Road Train = 80% (79 tonne)* • *B-Double combinations = 20% (45 tonnes)* *(aligns with assumptions made in the recent DPTI endorsed Eyre Peninsula Freight Study)*
Vehicle generation	***NOTE: All values below relate to the Stage 1 approval.***	
	Operation: ***Assumes site operation 365 days per year (i.e. limited on-site storage)*** • *Grain – 40 HVs per day (i.e. 70 in and out vehicle movements per day)* • *Hematite – 70 HVs per day (i.e. 140 in and out vehicle movements per day)* *Staff – 30 passenger vehicles per day (assumes 1 passenger vehicle per staff) (i.e. 60 in and out vehicle movements per day)*	Operation: **Assumes site receivals occur over an 8 week harvest season operating 17 hour days / 7 days a week, with ship exports occurring throughout the year** • Grain – up to 430 HVs per day (assumes a peak receivals day of up to 30,000 tonne) (i.e. peak of 860 in and out vehicle movements per day) ***OR*** an average of 230 HVs per day (uniform over a 8 week harvest season) (i.e. average of 460 in and out vehicle movements per day)

	Previous approved development application	New proposed Port Spencer facility
		• Hematite – N/A • Staff – during harvest season up to 60 passenger vehicles per day (assumes 1 passenger vehicle per staff, and two shifts per day) (*i.e. peak of 120 in and out vehicle movements per day)* Outside harvest season, up to 10 passenger vehicles per day (assumes 1 passenger vehicle per staff, and one shift per day) (*i.e. peak of 20 in and out vehicle movements per day)*
	Construction: *Construction workforce – 50 to 250 people on site at any one time* • *Expected – up to 20 trucks, 3 buses and 10 light vehicles per day (undertaking one trip in and one trip out per day)* • *Worst case – maximum 250 vehicle movements per hour (i.e. entire workforce drive individual vehicles)* *Material transport – not clearly defined*	Construction: Construction workforce – 150 personnel peak workforce on site at any one time • Expected worst case peak (Months 10 & 11) – up to 5 heavy vehicle (5 24-seater buses), and 149 light vehicle (7 12-seater buses, 3 light trucks, and 139 light vehicles) movements per day Material transport • Expected worst case peak (Month 2) – up to 25 heavy vehicles (19 CVs and 6 OD vehicles), and 68 light vehicles movements per day • Current design development envisages all bulk earthworks and rock being site won, significantly reducing the bulk materials haul task and therefore construction traffic impact. The scale of the development is significantly lower in terms of oversized and heavy materials deliveries comparative to the previous Centrex proposal.

3. Existing Area Conditions

3.1 Study Area

The site provides naturally deep water with depth to 20 metres within 500 metres of the shoreline, enabling Panamax or Cape class vessels with no requirement for dredging to facilitate port operations (i.e. to allow safe passage of vessels or to create a berth pocket for vessels). The landside component of the project is located on undulating terrain consisting of cleared farmland, heavily impacted by human activity and subject to erosion.

3.2 Study Area Land Use

The Port Spencer site is located within the jurisdiction of the Tumby Bay District Council Development Plan (consolidated 6 March 2018) and the Planning and Design Code As Applying To Land Not Within a Council Area (Version 1 – Published 1 July 2019) (refer Figure 4) .

More specifically, the Port Spencer landside development area is currently designated as a combination of Primary Production and Coastal Conservation land zonings.

Figure 2: Primary Production / Mining (orange) and Coastal Conservation (green) land zonings at the proposed development site (dark blue outline) (Source: Location SA Viewer)

Past the Port Spencer site and extending between the coastline and Lipson Cove Road, the land is designated as a Local Reserve. Within this Local Reserve, south of the Lipson Cove Road termination, a local heritage place is identified within the Development Plan (Wallaby Sam Monument). It is also noted that the Lipson Island is designated as a Conservation Park. None are directly impacted by the proposed development.

Figure 3: Local Reserves (light blue area) and Heritage Places (dark blue point) adjacent the proposed development site (dark blue outline) (Source: Location SA Viewer)

These land uses about the site and the current level of development of these areas are not considered to be significant trip generators.

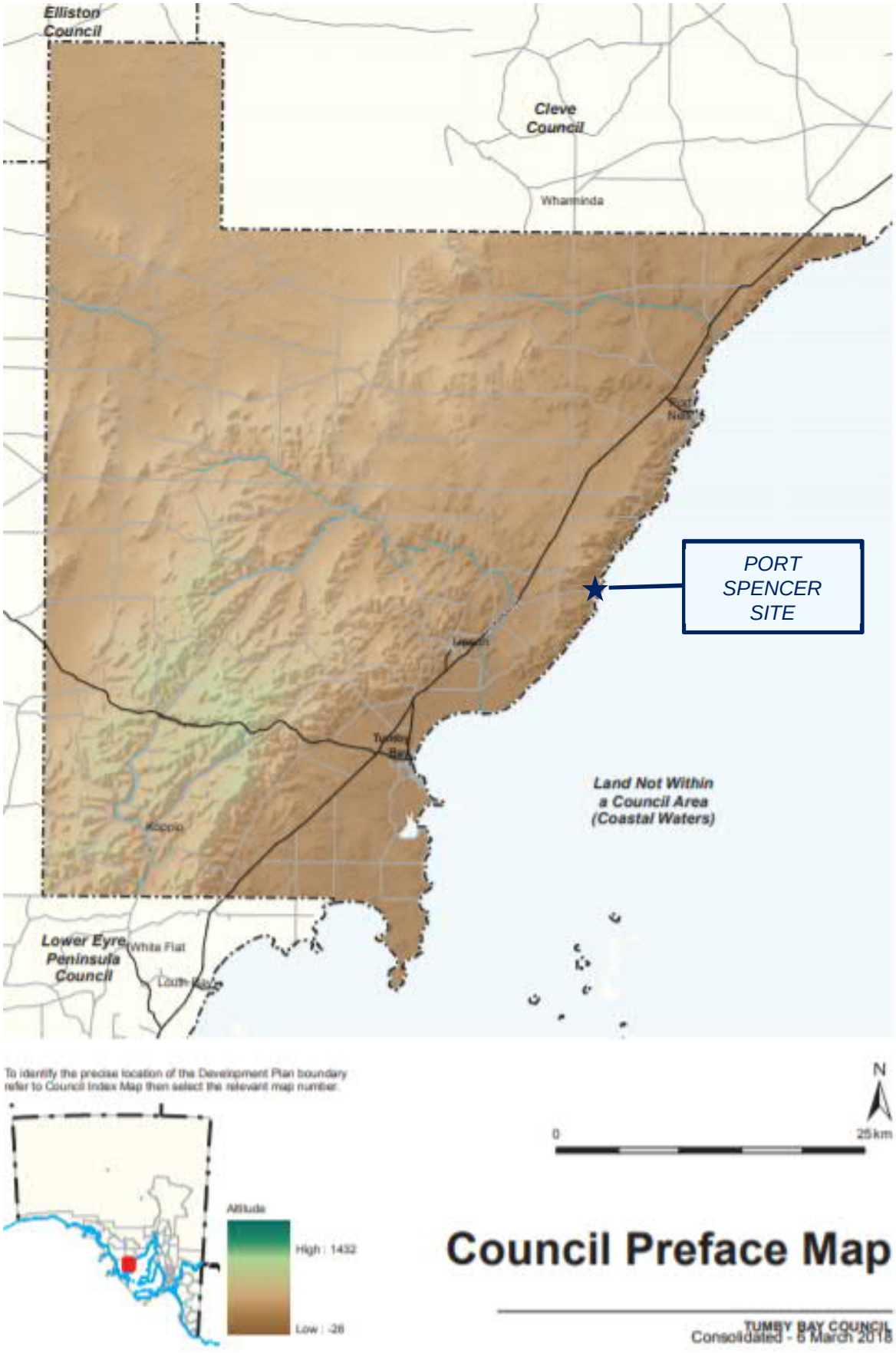

Figure 4: Extent of the Tumby Bay District Council area

3.3 Site Accessibility

Currently, road access to the Port Spencer site can be made via Lipson Cove Road only.

Figure 5: Sealed (solid grey line), unsealed (solid yellow line) and unformed roads (dashed grey line) in vicinity of the proposed site (dark blue outline) (Source: Location SA Viewer)

3.4 Existing Road Conditions

The existing road conditions adjacent to the Port Spencer development site are described following.

3.4.1 Lincoln Highway

Lincoln Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI), that extends some 300 km between the Eyre Highway (approximately 25km south-west from Port Augusta) and to the town centre of Port Lincoln, generally following the Eyre Peninsula's eastern coastline.

In the vicinity of the Port Spencer development site, the highway has a posted speed limit of 110 km/h, and has an approximate sealed width of 10 m with 3.6 m wide lanes and sealed shoulders in each direction.

Figure 6: Lincoln Highway looking south at Lipson Cove Road junction

Figure 7: Lincoln Highway looking north on approach to Lipson Cove Road junction

Approximately half the highway length between the Lipson Cove Road and Swaffers Road (i.e. in the vicinity of the Port Spencer development) has a single or double barrier line (i.e. no overtaking permitted). The road traverses areas of both cut and fill along its length, with an area of significant fill noted about the Swaffers Road junction with a culvert in place to maintain a natural watercourse which crosses the beneath the highway.

Figure 8: Lincoln Highway at Swaffers Road junction looking north

Figure 9: Lincoln Highway at Swaffers Road junction looking south

The original development application's traffic impact assessment noted the existing traffic volumes along the Lincoln Highway to be in the order of 750 vehicles per day (vpd), with approximately 17 percent commercial vehicle content (according to traffic data provided by DPTI dated October 2006). This assessment also reported a classification count along the highway (between Swaffers Road and Lipson Cove Road) dated between 6 and 8 April 2011, which indicated some growth on the highway section with traffic volumes of approximately 1,100 vpd recorded and 22.5 percent commercial vehicles.

However, on further investigation it was noted that the 2011 traffic data was collected during the school holiday period, and thus the previously reported growth is likely a capture of seasonal variability. More recent DPTI traffic data indicates the Lincoln Highway volumes (along the section between Tumby Bay and Arno Bay) to be in the order of 850 vpd with 17.5 percent (or 150 vpd) commercial vehicles (2014 data (month unknown) sourced from Location SA Viewer). This indicates significantly less growth along the highway.

The data outlined above does not factor in the impact of the recent railway line closure on the road network. It is noted that the recent Eyre Peninsula Fright Study (SMEC, 2018) reported the rail network to transport approximately 816,000 tonne of grain to Port Lincoln in 2017 (and approximately 1.1 million tonnes delivered by road).

As the railway line closure is a recent change to the transport network on the Eyre Peninsula (railway closure occurred 1 June 2019), the impact on the road network is not fully understood as a harvest season has not yet occurred to uncover the resultant transport impacts – it is understood that works are currently underway by DPTI to investigate the impact of this change on the wider Eyre Peninsula road network including along the Lincoln Highway.

The Eyre Peninsula Freight Study forecasted the impact of the railway closure to be an additional 30 freight vehicles movements (two-way volume) (assumed to be 70 tonne freight vehicles) per day on the Lincoln Highway between Wharminda Road and Tumby Bay, assuming this volume of grain would continue to be transported to Port Lincoln. In the town centre of Port Lincoln, the impact of the railway line closure was forecast to be 68 freight vpd. This assumes no seasonal variation to the transport of the grain. (Refer Table 3 on page 29 for the forecasted traffic impact of the railway line closure on the wider Eyre Peninsula road network.)

In addition to the railway closure, in early 2019 a new export port facility commenced grain receivals from Lucky Bay, located along the eastern coastline of the Eyre Peninsula approximately 180 km north-east of Port Lincoln and 120 km north-east of Port Spencer. The extent of trip redistribution of freight traffic on both the Lincoln Highway and throughout the wider Eyre Peninsula road freight network to this new export as a result of its trip generation is also not yet understood, but is hoped to be identified as part of the DPTI investigations currently underway.

The Lincoln Highway is currently gazetted for use by vehicles up to 36.5 m Road Trains (GML & HML) or PBS Level 3A vehicles, and for Over-Size / Over-Mass (OSM) vehicles up to 4.0 m Wide 93.5 t Low Loader and 6 Axle Cranes. Refer Appendix A for the Restricted Access Vehicle Network maps.

3.4.2 Lipson Cove Road

Lipson Cove Road is an unsealed road under the care and control of the District Council of Tumby Bay, that extends approximately 8 km east from Lincoln Highway to Lipson Cove on the Eyre Peninsula's eastern coastline. The road's junction from Lincoln Highway is located approximately 17 km north-east from Tumby Bay.

Figure 10: Lipson Cove Road junction with Lincoln Highway

Figure 11: Lipson Cove Road approach to Lincoln Highway

The road is located within a 20 m wide road corridor reserve, with a formed road width approximately 7 m to 8 m wide.

Figure 12: Lipson Cove Road on western approach to the proposed Port Spencer site entry point

Figure 13: Lipson Cove Road on eastern approach to the proposed Port Spencer site entry point

Figure 14: Lipson Cove Road looking east at the proposed Port Spencer site egress point

Figure 15: Lipson Cove Road on the eastern approach to the proposed Port Spencer site egress point

Given the unsealed nature of the road, the default rural speed limit of 100 km/h applies to this road. It was also observed that the road is signposted “Warning Gravel Roads Surface Conditions Change Often Drive Carefully” at the junction with Lincoln Highway (refer Figure 10 above), and has priority through the give-way controlled junction with South Coast Road (refer Figure 16 below).

Figure 16: Lipson Cove Road at South Coast Road junction looking east (give-way controls for South Coast Road)

Three rural properties are noted to have direct access points from Lipson Cove Road (refer Figure 17 below). Another property is noted to have access from South Coast Road in close proximity to the junction with Lipson Cove Road. Lipson Cove Road also provides the only direct access to the Lipson Cove reserve area and camping grounds (refer Figure 3 and Figure 5 above).

Figure 17: Rural Property Access Points (pink stars) in the vicinity of the proposed Port Spencer development (dark blue outline) (Source: Location SA Viewer)

The original development application's traffic impact assessment noted the traffic volumes along the Lipson Cove Road to be approximately 50 vpd, with approximately 10 percent commercial vehicle content (according to traffic counts undertaken as part of the assessment between 6 and 8 April 2011). It should be noted that this traffic data was collected during the school holiday period.

Lipson Cove Road is currently gazetted as a Grain Commodity Route for both B-doubles and Road Trains between Lincoln Highway and South Coast Road only. Refer Appendix A for the Restricted Access Vehicle Network maps.

3.4.3 Swaffers Road

Swaffers Road is an unsealed road under the care and control of the District Council of Tumby Bay, that extends approximately 4 km east from Lincoln Highway towards Lipson Cove. The road's junction from Lincoln Highway is located approximately 20 km north-east from Tumby Bay, and a further 3 km north-east from the Lipson Cove Road junction.

Figure 18: Swaffers Road approach to Lincoln Highway

The formed road, which is approximately 7 m to 8 m wide within a 20m wide corridor, terminates approximately 2 km short of the eastern coastline at a rural property access point (located approximately 1.5 km east of the road's intersection with South Coast Road). However, it is noted that the road corridor extends beyond this (refer Figure 5 above for the formed road extent, and Figure 17 above the rural property access points and cadastre property boundaries).

Three rural properties are noted to have direct access from Swaffers Road (refer Figure 17 above).

Given the unsealed nature of the road, the default rural speed limit of 100 km/h applies to this road. It was also observed that Swaffers Road is signposted "Warning Gravel Roads Surface Conditions Change Often Drive Carefully" at its junction with Lincoln Highway, and is give-way controlled at its intersection with South Coast Road (i.e. Swaffers Road yields to South Coast Road) (refer Figure 19). At the South Coast Road intersection, Swaffers Road is also signposted as a "no through road".

Figure 19: Swaffers Road at South Coast Road junction looking east towards the “no through road”

The traffic volumes along Swaffers Road are unknown to the author. It is noted that the original development application’s traffic impact assessment did not commission any traffic surveys along Swaffers Road to inform its assessment, only noting that *“given the low volumes on Lipson Cove Road, it is considered conservative to assume the same volumes on Swaffers Road in terms of existing traffic loading”.*

Swaffers Road is not gazetted as a part of the Grain Commodity Route, nor does it form part of any of the restricted access vehicle network gazettes. Refer Appendix A for the Restricted Access Vehicle Network maps.

3.4.4 South Coast Road

South Coast Road (note that the previous traffic impact assessment referenced this road as both Cove Road or Coast Road) is an unsealed road under the care and control of the District Council of Tumby Bay, that extends approximately 22 km between junctions with the Lincoln Highway. Generally, the road runs parallel to the Lincoln Highway and is located halfway between the highway and the eastern coastline, and is located within a 20 m wide road corridor with a road formation approximately 7 m to 8 m wide.

Figure 20: South Coast Road at Lipson Cove junction looking north

“Warning Gravel Roads Surface Conditions Change Often Drive Carefully” signage is observed at the both of the road’s junctions with the Lincoln Highway.

The traffic volumes along South Coast Road are unknown to the author. (It is noted that the original development application’s traffic impact assessment did not examine the road in detail, excepting for a visual

assessment at its intersections with Swaffers Road and Lipson Cove Road.) It is considered conservative to assume similar traffic volumes along South Coast Road to what was observed along Lipson Cove Road.

South Coast Road is not gazetted as a part of the Grain Commodity Route, nor does it form part of any of the restricted access vehicle network gazettes. Refer Appendix A for the Restricted Access Vehicle Network maps.

The road's northern junction with Lincoln Highway is undesirable as a heavy vehicle route due to the junction's configuration – South Coast Road and Kiandra Road merge into a single approach at the junction with Lincoln Highway (refer Figure 21 and Figure 22 below).

Figure 21: Lincoln Highway looking north at Kiandra Road / South Coast Road junction (left image), and aerial of junction (right image, source: Location SA Viewer)

Figure 22: South Coast Road approach to the Kiandra Road / Lincoln Highway junction

3.4.5 Restricted Access Vehicle Network – Grain Commodity Routes

A significant amount of the road network across the Eyre Peninsula forms part of the current approved restricted access vehicle network grain commodity routes for B-doubles and Road Trains. Refer Figure 23 below, or Appendix A for larger snapshots of these Restricted Access Vehicle Network maps.

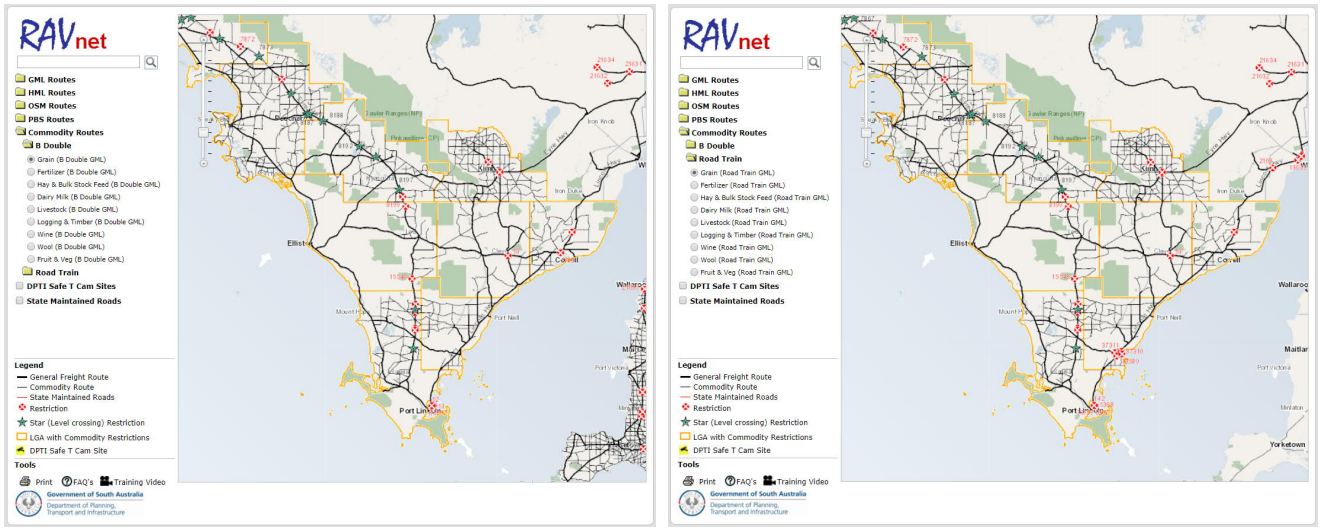

Figure 23: DPTI RAVNet network for B-Double (left) and Road Train (right) Grain Commodity and General Freight Routes (Source: DPTI RAVNet)

It should be noted that many of the current grain commodity routes are subject to council imposed restrictions which limit the speeds on sealed and unsealed roads, and through townships, and restrict specific freight movements. Refer to Appendix A for full details of the restrictions imposed along the Eyre Peninsula grain commodity routes.

Figure 24: Sign on council road outlining the Restricted Access Heavy Vehicle speed restrictions imposed by the Eyre Peninsula Local Government Association on council roads

4. Projected Operational Traffic Generation

4.1 Assumptions

It should be noted that this traffic impact assessment has been undertaken early in the planning phase of this project.

This initial traffic assessment is therefore based on the following assumptions, which considers a combination of initial information as provided by Free Eyre, other publicly available sources, and the professional judgement of the author, with consideration made of the original development assessment assumptions considered.

Grain production, storage and export facilities across the Eyre Peninsula

Historically, the Eyre Peninsula Region produces on average 2.464 million tonne of grain per annum (10 year average, 2007 – 2017) (PIRSA Eyre Peninsula Grain Production Trends: 5 and 10 years). However, production can vary significantly, noting the lowest production year for the region occurred in 2006-07 (drought year) (approx. 1.0 million tonnes) and highest production year occurred in 2016-17 (approx. 3.5 million tonnes).

Table 1 Main South Australian Crops - High and Low (drought) production years (tonnes). Source: PIRSA Crop and Pasture Report.

DISTRICT	2006-07 Production (Low Year)[2]					2016-17 Production (High Year - State record)[3]				
	Wheat[1]	Barley	Canola	Lentils	All Crops[4]	Wheat[1]	Barley	Canola	Lentils	All Crops[4]
Western Eyre Peninsula	262,650	77,490	1,782	100	354,785	955,000	138,000	12,000	3,000	1,153,080
Lower Eyre Peninsula	204,468	107,714	23,918	540	375,077	553,000	233,000	150,000	7,200	1,031,500
Eastern Eyre Peninsula	215,543	74,200	1,000	0	300,140	1,019,000	195,000	19,000	6,000	1,274,690
Total Eyre Peninsula	682,660	259,404	26,700	640	1,030,002	2,527,000	566,000	181,000	16,200	3,459,270

Table 2 Averages main Crops by district - 5 year average and 10 year State total (tonnes). Source: PIRSA Crop and Pasture Report.

DISTRICT	5 Year Average (2012 - 2017)					10 year average - all crops	
	Wheat[1]	Barley	Canola	Lentils	All Crops[4]	2007- 2017	% State Production
Western Eyre Peninsula	758,100	111,000	7,400	600	905,200	832,700	10.8%
Lower Eyre Peninsula	450,700	220,900	102,400	3,700	840,400	800,900	10.4%
Eastern Eyre Peninsula	762,300	154,800	10,900	1,200	952,000	830,800	10.7%
Total Eyre Peninsula	1,971,100	486,700	120,700	5,500	2,697,600	2,464,400	31.9%

NOTES:
[1] Wheat includes both bread and durum wheats
[2] 2006/07 drought was the lowest production year in SA in the last 20 years and the last serious drought the state has seen. Also note 2006/07 canola and lentils were still in growth phase as new crops, but the total area sown 2016/17 (3,927,000 ha) was similar to 2006/7 (3,894,000 ha).
[3] 2016-17 latest finalised PIRSA data of crop estimates by PIRSA crop reporting district released March 2017.
[4] Other crops included in the total: oats, ryecorn, triticale, lupins, peas, beans (fava and broad), chickpeas and vetch.

Figure 25: Eyre Peninsula Grain Production (tonnes) (Source: SA Grain Industry Overview – May 2017, PIRSA report for the ESCOSA Grain Supply Chain Cost Inquiry)

Viterra currently operates most of the gain storage and handling capacity in South Australia and within the Eyre Peninsula Region, including two grain export ports in the region; one deep sea port at Port Lincoln, one shallow port at Thevenard.

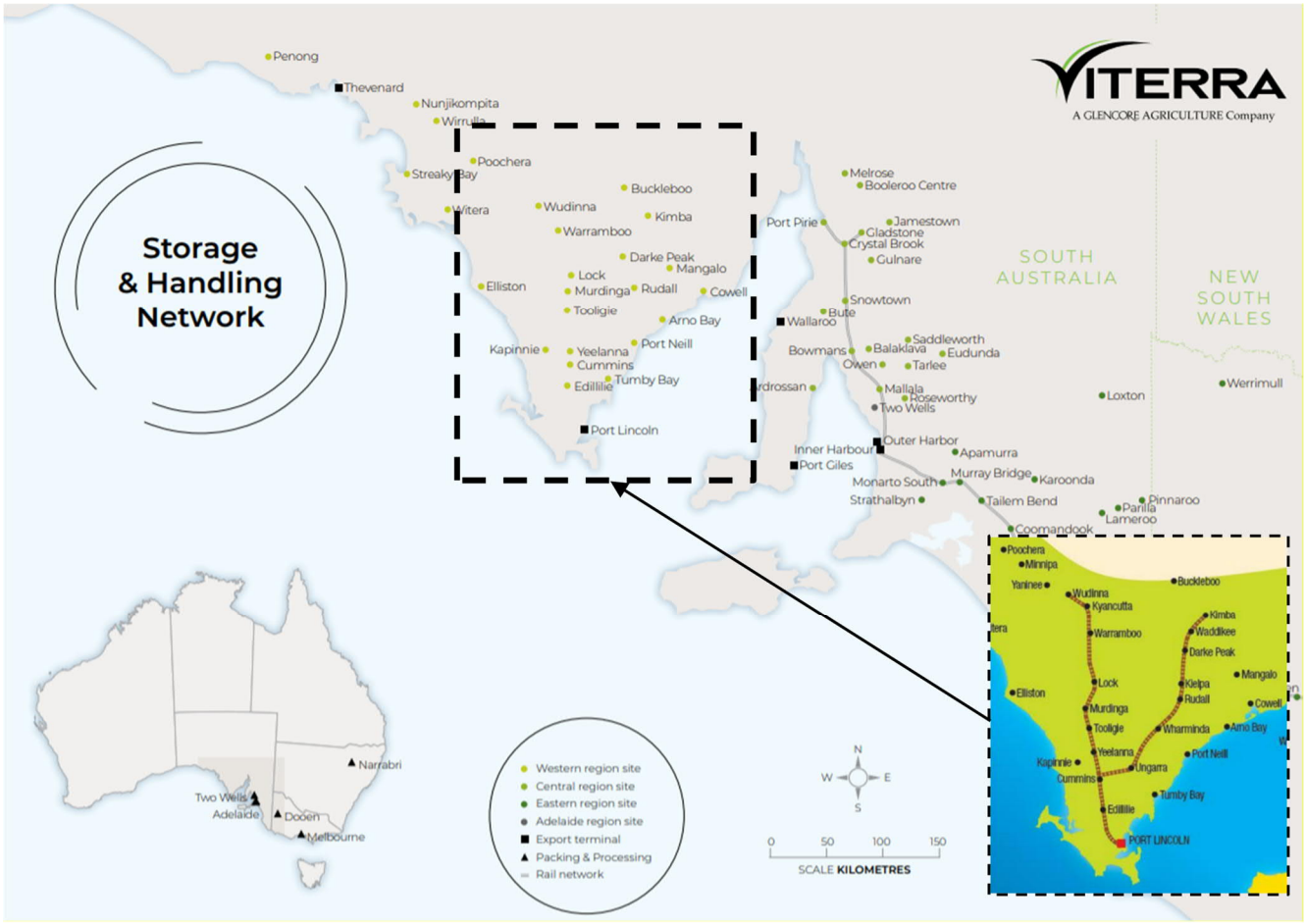

Figure 26: Viterra Grain Storage and Handling network within South Australia including the Eyre Peninsula (Western region site) post-closure of rail line (pre-closure of rail line shown in inset) (Source: Viterra website)

Recent changes to the operation of grain storage and export facilities

Until this year, the operation of grain storage and export facilities and means of transportation to these facilities had remained relatively unchanged over the last few decades. The recent significant changes of note are bulleted below:

- Prior to 31 May 2019, the Eyre Peninsula rail network was operated by Genesee & Wyoming Australia (GWA) under licence from the South Australian Government to transport grain to Viterra's Port Lincoln terminal. Now, the railway line is not operational.
- Viterra plans to close six silo sites on the Eyre Peninsula (that being Minnipa, Kyancutta, Cungena, Waddikee, Kielpa and Wharminda) prior to the 2019/20 harvest season.
- It is also noted that a new T-Ports grain export port at Lucky Bay is expected to be fully operational for the 2019/2020 harvest.

The impact of these recent changes to the grain storage and handling across the Eyre Peninsula during a harvest season is not yet understood but is thought to have a significant impact on the existing road freight network.

The potential impact of the rail closure on the existing road freight network

In 2017 (peak production year for Eyre Peninsula region), 1.9 million tonne of grain (54% of total production within the Eyre Peninsula) was delivered to Port Lincoln. Of this, 816,000 tonne (23% of total production) was delivered via rail, and approximately 1.1 million tonne (31% of total production) delivered by road (as reported in

the Eyre Peninsula Freight Study, SMEC, 2018). (The remaining 46% of total Eyre Peninsula production was assumed to be exported via the Thevenard port facility, and delivered via the road network)

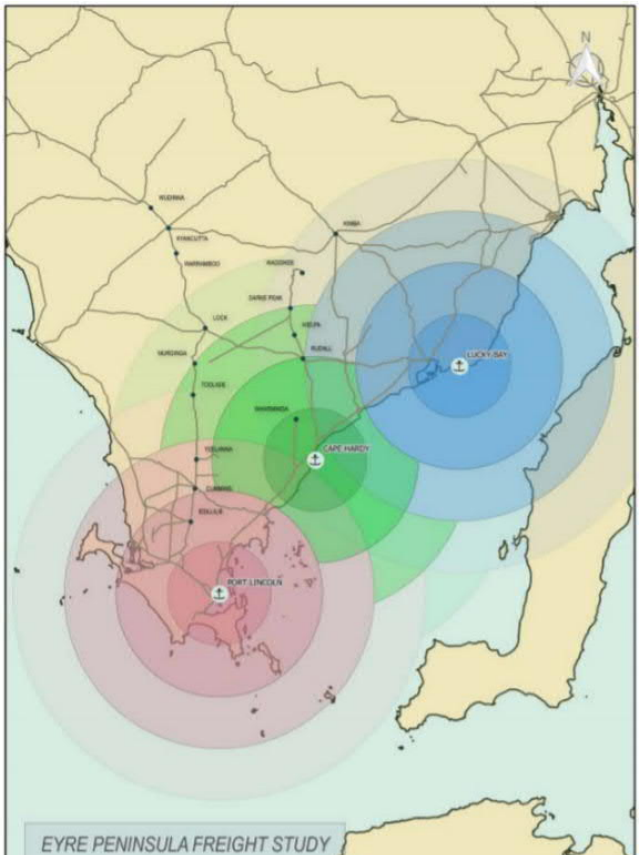

Figure 27: Proximity of future Eyre Peninsula ports (Source: Eyre Peninsula Freight Study, SMEC, 2018)

With the recent closure of the rail line (June 2019), grain to the Port Lincoln Port will now need to be transported via trucks on the road network.

A recent study commissioned and endorsed by the Department of Planning, Transport and Infrastructure (DPTI) and Genesee and Wyoming Australia (GWA) (Eyre Peninsula Freight Study, SMEC, September 2018) considered the impact of the rail line closure to be up to an additional 68 one-way freight vehicle movements daily (assuming an average payload of 70 tonnes per vehicle to be representative of a mixture of road fleet vehicles) to Port Lincoln, based on an assessment of the likely increase in grain freight tonnage and future grain production outlooks. This forecasted freight increase is an Annual Average Daily Traffic (AADT) increase.

Although the harvest season typically occurs over an 8-week period each year, exports via Port Lincoln occur all year round and it is known that Viterra accumulates grain up-country. Grain is only transported down to Port Lincoln from these up-country grain storages as required for shipping exports. Noting this, an annual average daily freight increase for the transport of grain to Port Lincoln is considered appropriate.

It should be noted that the Eyre Peninsula Freight Study does not consider the impact of the now operational port facility at Lucky Bay, or Peninsula Ports' future new port for Port Spencer (near Cape Hardy, refer Figure 27).

The potential impact of the new Lucky Bay port facility on the existing road freight network

As the new port facility at Lucky Bay is now operational, considerations have been made to the potential impact of this new trip generator on the existing road freight network. This new export port is assumed to attract a proportion of the grain freight traffic assumed to travel to Port Lincoln since the rail closure. Some assumptions have been made as to the Lucky Bay trip generation and redistribution to inform a new baseline situation (refer section 4.3).

4.2 Site Traffic Generation

The potential impact on the existing road freight network with Port Spencer

Port Spencer is expected to remove a proportion of the forecast traffic congestion from Port Lincoln (in conjunction with Lucky Bay) by offering an alternate grain receivals site and an alternate export port for the Eyre Peninsula, which would disperse the traffic impact on the existing road freight network (i.e. reduce the freight volumes to Port Lincoln) by adding competition to an otherwise monopolistic market and offer a more cost effective viable alternative for many farmers (i.e. by reducing the vehicle kilometres travelled).

The new Port Spencer port facility is anticipated to export up to 1 million tonnes of grain per annum with a storage capacity of 880,000 tonne. Furthermore, it is expected that the facility will be capable of handling peak

harvest loads of up to 30,000 tonnes per day (i.e. approximately 430 freight vehicle receivals per day or 25 freight vehicles receivals per hour if a 17 hour day is assumed).

This equates to one freight vehicle entering or exiting the site every 2 minutes on the peak receivals day.

Outside harvest season, the freight impact is expected to be significantly reduced as the site is not expected to receive any grain receivals for storage onsite outside harvest, but may accept grain from external storages for direct loading onto vessels as required to meet shipping exports.

The potential impact on the existing passenger vehicle road network with Port Spencer

In addition to the freight movements for grain receivals, staff movements require consideration. It is assumed that a maximum 30 staff be located on-site during a peak receivals day at any one time. If a 17 hour day is assumed for site operations, one staff rotation is anticipated as a minimum (8.5hr shift day per staff). If each staff employed travels in their own vehicle, up to 120 passenger vehicle movements entering or exiting the site over the course of a day (i.e. 60 passenger vehicles on-site on a peak receivals day during shift change – 30 vehicles entering, and 30 vehicles exiting during the shift change hour)

Outside harvest, up to 10 staff are envisaged to be located on-site each day throughout the remainder of the year. If each staff employed travels in their own vehicle, up to 20 passenger vehicle movements entering or exiting the site over the course of a day (i.e. up to 10 passenger vehicles on-site each day outside harvest season).

Site traffic distribution

All traffic to the development is assumed to travel via Lipson Cove Road from Lincoln Highway. Other assumptions are as follows:

- Freight vehicle trip distribution
    - An initial catchment analysis was undertaken by Free Eyre which considered an assessment of the potential receivals capture advantage to Port Spencer (when compared to either Port Lincoln and Lucky Bay), from 34 receivals sites across the Eyre Peninsula with consideration to distance and cost advantages. This initial catchment analysis is the basis of the 1 million tonne receivals per annum.
    - The average receivals at the receivals sites assumed to redistribute from Port Lincoln to Port Spencer (and Lucky Bay) were considered, the assumed trip generation has been split between the sites based on the percentage of receivals from each location.
    - Trips have been assigned to road link segments along the routes with the shortest travel times, noting the existing gazettal routes (including restrictions and extent of the sealed road network) and assumed trip origins.
- Passenger vehicle trip distribution:

40 percent of staff trips has an origin or destination in Tumby Bay.

20 percent to each Arno Bay, Port Lincoln and Cummins.

This catchment area assumes a maximum one way trip length of 45 minutes.

Refer Table 4 (on page 35) for a breakdown of the site trip generation and distributions assumed by road link segment.

4.3 Changes to Through Traffic

4.3.1 New Baseline Traffic – All previous rail transportation of grain via road to Port Lincoln + Lucky Bay trip redistribution

As the existing transport situation across the wider Eyre Peninsula road network will be impacted by the recent closure of the railway line and new export port at Lucky Bay, a new baseline transport situation need be considered to inform the likely transport impact of the Port Spencer development.

The base case scenario as was proposed in the Eyre Peninsula Freight Study with the railway line closure with all trips redistributed along the existing road network to Port Lincoln (as endorsed by DPTI), is considered an appropriate starting basis for the new baseline transport situation (given the lack of other observed traffic volumes since the railway line closure). However, consideration also need to be given to Lucky Bay as a new grain freight trip attractor.

A grain production catchment analysis for the wider Eyre Peninsula region (as undertaken by Peninsula Ports to inform the feasibility of the proposed Port Spencer development) with consideration of the capacities and historical productions to existing grain receival sites, and assumed costs per tonne advantages from the existing grain receivals sites to the Port Lincoln and Lucky Bay has informed the assumed trip generation and redistribution from Port Lincoln to Lucky Bay. This assumes that of 1.816 million tonne of grain assumed to be typically exported from Port Lincoln annually, 1.134 million tonne would be redistributed to Lucky Bay annually. Lucky Bay was also assumed to accept grain receivals all-year round, giving an average of 45 70-tonne vehicles unloading at Lucky Bay per day (or 90 70-tonne vehicle movements per day).

Table 4 below shows the Eyre Peninsula Freight Study assumed base case (daily) traffic volumes along key routes impacted by the railway line closure, assuming all rail transport is be transported on the road network to Port Lincoln, in addition to the assumed trip redistribution to Lucky Bay (i.e. without additional Port Spencer trip generation).

Table 3: Forecast volumes across key road links on the Eyre Peninsula for New Baseline transport situation (i.e. all previous rail transportation of grain via road to Port Lincoln + Lucky Bay trip redistribution)

				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	NEW BASELINE TRANSPORT SITUATION (FREIGHT STUDY BASE CASE + LUCKY BAY TRIP GENERATION - LUCKY BAY TRIP REDISTRIBUTION)	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
1	Eyre Hwy	Wudinna Stn	Kyancutta Stn	1010	300	10	1020	310	0	0	1020	310
2	Tod Hwy	Kyancutta Stn	Warramboo Stn	250	70	14	264	84	0	0	264	84
3	Tod Hwy	Warramboo Stn	Lock Stn	260	90	16	276	106	0	0	276	106
4	Tod Hwy	Lock Stn	Murdinga Stn	280	70	26	306	96	3	0	309	99
5	Tod Hwy	Murdinga Stn	Tooligie Stn	240	40	28	268	68	2	2	268	68
6	Tod Hwy	Tooligie Stn	Yeelanna Stn	240	40	30	270	70	0	3	267	67
7	Tod Hwy	Yeelana Stn	Cummins	610	110	34	644	144	3	6	641	141
8	Tod Hwy	Cummins	Edillilie	910	260	66	976	326	2	40	938	288
9	Tod Hwy	Edillilie	Flinders Hwy	760	190	68	828	258	0	40	788	218
10	Flinders Hwy	Flinders Hwy	Western Approach Road	2170	290	68	2238	358	0	40	2198	318
11	Cleve Rd	Kimba	Mangalo Road	250	60	8	258	68	0	0	258	68
12	Cleve Rd	Mangalo Road	Cleve	410	60	8	418	68	2	2	418	68
13	Unnamed Road	Waddikee	Balumbah-Kinnard Rd	200	30	2	202	32	0	0	202	32
14	Balumbah-Kinnard Rd	Road	Darke Peak	200	30	2	202	32	0	0	202	32
15	Balumbah-Kinnard Rd	Darke Peak	Kielpa	200	30	4	204	34	0	0	204	34
16	Balumbah-Kinnard Rd	Kielpa	Rudall	200	30	6	206	36	0	0	206	36
17	Balumbah-Kinnard Rd	Rudall	Lincoln Hwy	200	30	15	215	45	0	0	215	45
18	Birdseye Hwy	Rudall	Cleve	360	60	5	365	65	9	0	374	74
19	Arno Bay	Cleve	Arno Bay	420	80	13	433	93	0	2	431	91
20	Lincoln Hwy	Arno Bay	Balumbah-Kinnard Rd	860	150	13	873	163	71	11	933	223
21	Lincoln Hwy	Balumbah-Kinnard Rd	Wharminda Road	890	160	28	918	188	71	13	976	246
22	Wharminda Road	Wharminda	Lincoln Hwy	100	20	2	102	22	2	2	102	22
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	850	150	30	880	180	68	14	934	234
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	850	150	30	880	180	68	14	934	234
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	850	150	30	880	180	67	45	902	202
24	Lincoln Hwy	Tumby Bay	Louth Bay	1620	280	30	1650	310	0	45	1605	265
25a	Lincoln Hwy	Louth Bay	Richardson Road	3780	460	30	3810	490	0	45	3765	445
25b	Lincoln Hwy	Richardson Road	Happy Valley Road	5050	360	30	5080	390	0	45	5035	345
25c	Lincoln Hwy	Happy Valley Road	Normandy Place	8280	390	30	8310	420	0	45	8265	375
25d	Lincoln Hwy	Normandy Place	Flinders Hwy	8790	360	30	8820	390	0	45	8775	345
26a	Lincoln Hwy	Flinders Hwy	New W Road	11310	410	30	11340	440	0	45	11295	395
26b	Lincoln Hwy	New W Road	Porter St (Port Access)	13740	390	30	13770	420	0	45	13725	375
27	Flinders Hwy	Flinders Hwy	Lincoln Hwy	3640	330	0	3640	330	0	0	3640	330
28a	West Approach Road	Flinders Hwy	New W Road	1720	290	68	1788	358	0	46	1742	312

				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	NEW BASELINE TRANSPORT SITUATION (FREIGHT STUDY BASE CASE + LUCKY BAY TRIP GENERATION - LUCKY BAY TRIP REDISTRIBUTION)	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
28b	West Approach Road	New W Road	Pine Freezers Road	1920	420	68	1988	488	0	46	1942	442
28c	West Approach Road	Pine Freezers Road	Anne Street	3430	330	68	3498	398	0	46	3452	352
28d	West Approach Road	Anne Street	Mortlock Terrace	6870	360	68	6938	428	0	46	6892	382
28e	West Approach Road	Mortlock Terrace	Dublin Street	11310	560	68	11378	628	0	46	11332	582
28f	West Approach Road	Dublin Street	Porter St (Port Access)	6160	430	68	6228	498	0	46	6182	452
	BRATTEN WAY	FLINDERS HIGHWAY	KAPINNIE	TBA	TBA	-	0	0	0	0	0	0
	BRATTEN WAY	KAPINNIE	CUMMINS	TBA	TBA	-	0	0	2	2	0	0
	BRATTEN WAY	CUMMINS	Tumby Bay	300	60	-	300	60	37	0	337	97
	FLINDERS HIGHWAY	COFFIN BAY ROAD	TOD HWY	1300	80	-	1300	80	0	6	1294	74
	FLINDERS HIGHWAY	WANGARY	COFFIN BAY ROAD	600	75	-	600	75	0	6	594	69
	FLINDERS HIGHWAY	WARROW ROAD	WANGARY	400	50	-	400	50	0	6	394	44
	FLINDERS HIGHWAY	BRATTEN WAY	WARROW ROAD	290	40	-	290	40	0	6	284	34
	FLINDERS HIGHWAY	ELLISTON	BRATTEN WAY	290	40	-	290	40	0	6	284	34
	FLINDERS HIGHWAY	WITERA	ELLISTON	330	48	-	330	48	6	6	330	48
	UNGRARRA ROAD	UNGARRA	LINCOLN HIGHWAY	TBA	TBA	-	0	0	2	2	0	0
	BIRDSEYE HWY	LOCK	RUDALL	TBA	TBA	-	0	0	9	0	+9	+9
	BIRDSEYE HWY	CLEVE	COWELL	TBA	TBA	-	0	0	12	0	+12	+12
	LINCOLN HIGHWAY	ARNO BAY	COWELL	TBA	TBA	-	0	0	76	3	+73	+73
	LINCOLN HIGHWAY	COWELL	LUCKY BAY	TBA	TBA	-	0	0	90	0	+90	+90

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

4.3.2 Port Spencer Trip Redistribution

It should be noted that the Port Spencer traffic impact assessment is currently in its early stages of development, which aims to identify the preliminary transport impact of the new port facility on the existing road network.

As the new baseline transport situation to inform the traffic impact of the proposed Port Spencer development considers the base case scenario as was proposed in the Eyre Peninsula Freight Study with the railway line closure with an additional trip redistribution for Lucky Bay only, additional trip redistributions need also be considered for Port Spencer and a reduced trip redistribution to Lucky Bay (to account for the change in trip attraction from Lucky Bay to Port Spencer).

Initial desktop investigations have identified an extensive gazettal throughout the region for seasonal B-Double and Road Trian grain freight routes, which will help distribute the expected new traffic generation to the site from numerous origins across the Eyre Peninsula, and remove a proportion of freight traffic from the road network towards to Port Lincoln.

The Lincoln Highway is thought to be the most directly impacted freight route between the three proposed grain export port trip generators along the eastern Eyre Peninsula coastline. Although it is acknowledged that other freight routes will also experience a trip redistribution, the extent to which this may occur has not been considered in detail as part of this assessment (difficult to predict, given the number changes about the transport network and number of unknowns).

A potential redistribution of traffic to Lucky Bay has been considered in addition to the redistribution to Port Spencer. Although the redistributions are an unknown factor at this stage (as dependent on the commercial arrangements of each of the export ports), catchment analysis for Port Spencer with Lucky Bay (as provided by Peninsula Ports) assumes that of 1.816 million tonne of grain assumed to be typically exported from Port Lincoln historically per year, 159,000 tonne would be redistributed to Lucky Bay annually, and 975,000 tonne would be redistributed to Port Spencer annually. As assumed for the *New Baseline Transport Scenario*, Lucky Bay was assumed to accept grain receivals all-year round, this assumption results in an average of approximately 7 70-tonne vehicles unloading at Lucky Bay per day (or 13 70-tonne vehicle movements per day) – this is less than the *New Baseline Transport Scenario* as Port Spencer is assumed to reduce the redistribution to Lucky Bay that would otherwise be exported at Port Lincoln. Port Spencer is assumed to accept grain receivals during an eight week harvest season only, capable of catering for a peak receivals day of 30,000 tonne.

It should be noted that the previous PER for Centrex assumed approximately 1.05 million tonnes per annum of grain to Port Spencer, with receivals all-year round. The updated proposal for Port Spencer considers similar grain tonnage receivals per annum (up to 1 million tonnes per annum), except that the receivals are assumed during an eight week harvest season only and not throughout the year as was previously assumed.

Several scenarios for the trip redistribution have been considered in assessing the impact of the proposed Port Spencer development (as discussed with DPTI and Council), as detailed following:

- *New Baseline Transport Situation* (refer Section above)
- *Scenario 1* – Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with **Uniform** Trip Generation
- *Scenario 2* – Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with **Peak** Trip Generation
- *Scenario 3* – Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) with **Peak** Trip Generation, **and** east-west trip redistribution via other unsealed council routes, such that:

A) 100% via other east-west unsealed council routes

B) 50% via other unsealed council routes, 50% via Bratten Way.

The Port Spencer Trip Redistribution Scenarios are detailed in the following section.

4.4 Total Traffic Impact

4.4.1 Scenario 1: Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with Uniform Trip Generation

The following sections summarise the total traffic impact of Scenario 1 along roads in the vicinity of the Port Spencer site, based on the abovementioned assumptions for an average receivals day (i.e. approx. 18,125 tonnes per day receivals over an eight week harvest season):

Lipson Cove Road

Average daily volume (average receivals day of 18,125 tonnes per day is assumed, over eight week harvest season)

- TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (50 vpd) + (519 + 120) – (0) + (0) – (0) = 689 daily volume (two-way volume)
- CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (5 vpd) + (519) – (0) + (0) – (0) = 524 daily volume (two-way volume)

Average Day peak hour volume (average receivals day assume mid-day shift change, & uniform site receivals per hour over a 17hr day)

TOTAL = (50*10%) + ((30*2) + (519/17)) – (0) + (0) – (0) = 5 + 60 + (30) = 95 vehicles in peak hour (two-way volume)

CVs = (5*10%) + (519/17) – (0) + (0) – (0) = 5 + 30 = approx. 35 vehicles in peak hour (two-way volume)

Lincoln Highway

Average daily volume

- North of Port Spencer
  - TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (880) + (24 + 9) – (2) + (0) – (13) = approx. 898 daily volume (two-way volume)
  - CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (180) + (9) – (2) + (0) – (13) = approx. 174 daily volume (two-way volume)
- South of Port Spencer

TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (880) + (96 + 510) – (3) + (0) – (13) = approx. 1470 daily volume (two-way volume)

CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (180) + (510) – (3) + (0) – (13) = approx. 674 daily volume (two-way volume)

Average Day peak hour volume

- North of Port Spencer

TOTAL = (880*10%) + [(519/17)*2% + (30*2)*20%] – (2*10%) + (0) – (13*10%) = (88) + (1 + 12) – (0) + (0) – (2) = approx. 99 vehicles in peak hour (two-way volume)

CVs = (180*10%) + [(519/17)*2%] – (2*10%) + (0) – (13*10%) = (18) + (1) – (0) + (0) – (2) = approx. 17 vehicles in peak hour (two-way volume), split:

less than 1 left turning vehicles into Lipson Cove Road

less than 1 right turning vehicles from Lipson Cove Road

- South of Port Spencer

TOTAL = (880*10%) + [(519/17)*98% + (30*2)*80%] - (3*10%) + (0) – (13*10%) = (88) + (30 + 48) – (0) + (0) – (2) = approx. 158 vehicles in peak hour (two-way volume)

CVs = (180*10%) + [(519/17)*98%] – (3*10%) + (0) – (13*10%) = (18) + (30) – (0) + (0) – (2) = approx. 46 vehicles in peak hour (two-way volume), split:

approx. 15 right turning vehicles into Lipson Cove Road

approx. 15 left turning vehicles from Lipson Cove Road

Wider Eyre Peninsula Road Network

Table 4 below shows the assumed total traffic volumes along key routes within the wider Eyre Peninsula road network, split by road segment to show breakdown of Freight Study Base Case, the additional Port Spencer Trip Generation and reduction for the Trip Redistribution from Port Lincoln to Port Spencer, the additional Lucky Bay Trip Generation and reduction for the Trip Redistribution from Port Lincoln to Lucky Bay.

It should be noted that the site trip generation assumes uniform receivals day during a harvest period of eight weeks, whereas the base traffic considers an annual average daily traffic volume (which evens out the seasonal peak fluctuations that may be experienced along certain road segments during a harvest season).

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Table 4: Indicative forecast volumes across key road links on the Eyre Peninsula for Scenario 1 (Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with Uniform Trip Generation)

				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		PORT SPENCER IMPACT				TRIP REDISTRIBUTION - PORT LINCON TO PORT SPENCER	LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	SCENARIO 1 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)			
									FOR 8 WEEK HARVEST SEASON - UNIFORM		OUTSIDE HARVEST SEASON					FOR 8 WEEK HARVEST SEASON		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
1	Eyre Hwy	Wudinna Stn	Kyancutta Stn	1010	300	10	1020	310	0	0	0	0	0	0	0	1020	310	1020	310
2	Tod Hwy	Kyancutta Stn	Warramboo Stn	250	70	14	264	84	0	0	0	0	0	0	0	264	84	264	84
3	Tod Hwy	Warramboo Stn	Lock Stn	260	90	16	276	106	0	0	0	0	0	0	0	276	106	276	106
4	Tod Hwy	Lock Stn	Murdinga Stn	280	70	26	306	96	0	0	0	0	0	0	0	306	96	306	96
5	Tod Hwy	Murdinga Stn	Tooligie Stn	240	40	28	268	68	0	11	0	0	2	0	0	277	77	266	66
6	Tod Hwy	Tooligie Stn	Yeelanna Stn	240	40	30	270	70	0	19	0	0	3	0	0	286	86	267	67
7	Tod Hwy	Yeelana Stn	Cummins	610	110	34	644	144	0	35	0	0	6	0	0	673	173	638	138
8	Tod Hwy	Cummins	Edillilie	910	260	66	976	326	0	13	0	0	7	0	0	982	332	969	319
9	Tod Hwy	Edillilie	Flinders Hwy	760	190	68	828	258	0	0	0	0	7	0	0	821	251	821	251
10	Flinders Hwy	Flinders Hwy	Western Approach Road	2170	290	68	2238	358	0	0	0	0	45	0	0	2193	313	2193	313
11	Cleve Rd	Kimba	Mangalo Road	250	60	8	258	68	0	0	0	0	0	0	0	258	68	258	68
12	Cleve Rd	Mangalo Road	Cleve	410	60	8	418	68	0	0	0	0	0	2	2	418	68	418	68
13	Unnamed Road	Waddikee	Balumbah-Kinnard Rd	200	30	2	202	32	0	0	0	0	0	0	0	202	32	202	32
14	Balumbah-Kinnard Rd	Road	Darke Peak	200	30	2	202	32	0	0	0	0	0	0	0	202	32	202	32
15	Balumbah-Kinnard Rd	Darke Peak	Kielpa	200	30	4	204	34	0	0	0	0	0	0	0	204	34	204	34
16	Balumbah-Kinnard Rd	Kielpa	Rudall	200	30	6	206	36	0	0	0	0	0	0	0	206	36	206	36
17	Balumbah-Kinnard Rd	Rudall	Lincoln Hwy	200	30	15	215	45	0	0	0	0	0	0	0	215	45	215	45
18	Birdseye Hwy	Rudall	Cleve	360	60	5	365	65	0	0	0	0	0	0	0	365	65	365	65
19	Arno Bay	Cleve	Arno Bay	420	80	13	433	93	0	0	0	0	0	0	2	431	91	431	91
20	Lincoln Hwy	Arno Bay	Balumbah-Kinnard Rd	860	150	13	873	163	24	0	4	0	0	3	11	889	155	869	155
21	Lincoln Hwy	Balumbah-Kinnard Rd	Wharminda Road	890	160	28	918	188	24	0	4	0	0	3	13	932	178	912	178
22	Wharminda Road	Wharminda	Lincoln Hwy	100	20	2	102	22	0	9	0	0	2	0	0	109	29	100	20
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	850	150	30	880	180	24	9	4	0	2	0	13	898	174	869	165
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	850	150	30	880	180	96	510	16	0	3	0	13	1470	674	880	164
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	850	150	30	880	180	96	501	16	0	33	0	13	1431	635	850	134
24	Lincoln Hwy	Tumby Bay	Louth Bay	1620	280	30	1650	310	24	0	4	0	33	0	13	1628	264	1608	264
25a	Lincoln Hwy	Louth Bay	Richardson Road	3780	460	30	3810	490	24	0	4	0	33	0	13	3788	444	3768	444
25b	Lincoln Hwy	Richardson Road	Happy Valley Road	5050	360	30	5080	390	24	0	4	0	33	0	13	5058	344	5038	344
25c	Lincoln Hwy	Happy Valley Road	Normandy Place	8280	390	30	8310	420	24	0	4	0	33	0	13	8288	374	8268	374

				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		PORT SPENCER IMPACT				TRIP REDISTRIBUTION - PORT LINCON TO PORT SPENCER	LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	SCENARIO 1 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)			
									FOR 8 WEEK HARVEST SEASON - UNIFORM		OUTSIDE HARVEST SEASON					FOR 8 WEEK HARVEST SEASON		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
25d	Lincoln Hwy	Normandy Place	Flinders Hwy	8790	360	30	8820	390	24	0	4	0	33	0	13	8798	344	8778	344
26a	Lincoln Hwy	Flinders Hwy	New W Road	11310	410	30	11340	440	24	0	4	0	33	0	13	11318	394	11298	394
26b	Lincoln Hwy	New W Road	Porter St (Port Access)	13740	390	30	13770	420	24	0	4	0	33	0	13	13748	374	13728	374
27	Flinders Hwy	Flinders Hwy	Lincoln Hwy	3640	330	0	3640	330	0	0	0	0	0	0	0	3640	330	3640	330
28a	West Approach Road	Flinders Hwy	New W Road	1720	290	68	1788	358	0	0	0	0	45	0	0	1743	313	1743	313
28b	West Approach Road	New W Road	Pine Freezers Road	1920	420	68	1988	488	0	0	0	0	45	0	0	1943	443	1943	443
28c	West Approach Road	Pine Freezers Road	Anne Street	3430	330	68	3498	398	0	0	0	0	45	0	0	3453	353	3453	353
28d	West Approach Road	Anne Street	Mortlock Terrace	6870	360	68	6938	428	0	0	0	0	45	0	0	6893	383	6893	383
28e	West Approach Road	Mortlock Terrace	Dublin Street	11310	560	68	11378	628	0	0	0	0	45	0	0	11333	583	11333	583
28f	West Approach Road	Dublin Street	Porter St (Port Access)	6160	430	68	6228	498	0	0	0	0	45	0	0	6183	453	6183	453
	BRATTEN WAY	FLINDERS HIGHWAY	KAPINNIE	TBA	TBA	-	0	0	0	40	0	0	0	0	0	+40	+40	0	0
	BRATTEN WAY	KAPINNIE	CUMMINS	TBA	TBA	-	0	0	0	48	0	0	2	0	0	+46	+46	-2	-2
	BRATTEN WAY	CUMMIN S	Tumby Bay	300	60	-	300	60	24	303	4	0	0	0	0	627	363	304	60
	FLINDERS HIGHWAY	COFFIN BAY ROAD	TOD HWY	1300	80	-	1300	80	0	0	0	0	6	0	0	1294	74	1294	74
	FLINDERS HIGHWAY	WANGARY	COFFIN BAY ROAD	600	75	-	600	75	0	0	0	0	6	0	0	594	69	594	69
	FLINDERS HIGHWAY	WARROW ROAD	WANGARY	400	50	-	400	50	0	0	0	0	6	0	0	394	44	394	44
	FLINDERS HIGHWAY	BRATTEN WAY	WARROW ROAD	290	40	-	290	40	0	0	0	0	6	0	0	284	34	284	34
	FLINDERS HIGHWAY	ELLISTON	BRATTEN WAY	290	40	-	290	40	0	40	0	0	6	0	0	324	74	284	34
	FLINDERS HIGHWAY	WITERA	ELLISTON	330	48	-	330	48	0	35	0	0	6	0	0	359	77	324	42
	UNGRARRA ROAD	UNGARRA	LINCOLN HIGHWAY	TBA	TBA	-	0	0	0	9	0	0	2	0	0	+7	+7	-2	-2
	BIRDSEYE HWY	CLEVE	COWELL	TBA	TBA	0	0	0	0	0	0	0	0	2	0	+2	+2	+2	+2
	LINCOLN HIGHWAY	ARNO BAY	COWELL	TBA	TBA	0	0	0	0	0	0	0	0	8	4	+4	+4	+4	+4
	LINCOLN HIGHWAY	COWELL	LUCKY BAY	TBA	TBA	0	0	0	0	0	0	0	0	13	0	+13	+13	+13	+13

** ***Bold italic*** values highlight when the *Scenario 1* impact "*for 8 week harvest season"* is different to the impact *"outside harvest season"*

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

4.4.2 Scenario 2 – Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with Peak Trip Generation

The following sections summarise the total traffic impact of Scenario 2 along roads in the vicinity of the Port Spencer site, based on the abovementioned assumptions for a peak receivals day (i.e. a 30,000 tonne peak receivals day):

Lipson Cove Road

Peak Day daily volume (peak receivals day, i.e. 30,000 tonne peak receival day, during an eight week harvest season)

- TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (50 vpd) + (857 + 120) – (0) + (0) – (0) = 1027 daily volume (two-way volume)
- CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (5 vpd) + (857) – (0) + (0) – (0) = 862 daily volume (two-way volume)

Peak Day peak hour volume (average receivals day assumes mid-day shift change & uniform site receivals per hour over a 17hr day)

TOTAL = (50*10%) + [(30*2) + (857/17)] – (0) + (0) – (0) = 5 + 60 + (50) = 115 vehicles in peak hour (two-way volume)

CVs = (5*10%) + (857/17) – (0) + (0) – (0) = 1 + 50 = approx. 51 vehicles in peak hour (two-way volume)

Lincoln Highway

Average daily volume

- North of Port Spencer
  - TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (880) + (24 + 15) – (2) + (0) – (13) = approx. 904 daily volume (two-way volume)
  - CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (180) + (15) – (2) + (0) – (13) = approx. 180 daily volume (two-way volume)
- South of Port Spencer

TOTAL = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (880) + (96 + 843) – (3) + (0) – (13) = approx. 1803 daily volume (two-way volume)

CVs = (Freight Study Base Case) + (Trip Generation to Port Spencer) – (Trip Redistribution from Port Lincoln to Port Spencer) + (Trip Generation to Lucky Bay) – (Trip Redistribution from Port Lincoln to Lucky Bay) = (180) + (843) – (3) + (0) – (13) = approx. 1007 daily volume (two-way volume)

Average Day peak hour volume

- North of Port Spencer (approx. 2% CV arrivals from north)

TOTAL = (880*10%) + [(857/17)*2% + (30*2)*20%] - (2*10%) + (0) – (13*10%) = (88) + (1 + 12) – (0) + (0) – (2) = approx. 99 vehicles in peak hour (two-way volume)

CVs = (180*10%) + [(857/17)*2%] – (2*10%) + (0) – (13*10%) = (18) + (1) – (0) + (0) – (2) = approx. 17 vehicles in peak hour (two-way volume), split:

less than 1 left turning vehicles into Lipson Cove Road

less than 1 right turning vehicles from Lipson Cove Road

- South of Port Spencer (approx. 98% CV arrivals from south)

TOTAL = (880*10%) + [(857/17)*98% + (30*2)*80%] - (3*10%) + (0) – (13*10%) = (88) + (50 + 48) – (0) + (0) – (2) = approx. 184 vehicles in peak hour (two-way volume)

CVs = (180*10%) + [(857/17)*98%] – (3*10%) + (0) – (13*10%) = (18) + (50) – (0) + (0) – (2) = approx. 70 vehicles in peak hour (two-way volume), split:

approx. 24 right turning vehicles into Lipson Cove Road

approx. 24 left turning vehicles from Lipson Cove Road

Wider Eyre Peninsula Road Network

Table 5 below shows the assumed total traffic volumes along key routes within the wider Eyre Peninsula road network, split by road segment to show breakdown of Freight Study Base Case, the additional Port Spencer Trip Generation and reduction for the Trip Redistribution from Port Lincoln to Port Spencer, the additional Lucky Bay Trip Generation and reduction for the Trip Redistribution from Port Lincoln to Lucky Bay.

It should be noted that the site trip generation assumes a peak receivals day during a harvest period, whereas the base traffic considers an annual average daily traffic volume (which evens out the seasonal peak fluctuations that may be experienced along certain road segments during a harvest season).

Table 5: Indicative forecast volumes across key road links on the Eyre Peninsula for Scenario 2 (Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) via sealed road network with Peak Trip Generation)

`				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		PORT SPENCER IMPACT				TRIP REDISTRIBUTION - PORT LINCON TO PORT SPENCER	LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	SCENARIO 2 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)			
									FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON					FOR 8 WEEK HARVEST SEASON		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
1	Eyre Hwy	Wudinna Stn	Kyancutta Stn	1010	300	10	1020	310	0	0	0	0	0	0	0	1020	310	1020	310
2	Tod Hwy	Kyancutta Stn	Warramboo Stn	250	70	14	264	84	0	0	0	0	0	0	0	264	84	264	84
3	Tod Hwy	Warramboo Stn	Lock Stn	260	90	16	276	106	0	0	0	0	0	0	0	276	106	276	106
4	Tod Hwy	Lock Stn	Murdinga Stn	280	70	26	306	96	0	0	0	0	0	0	0	306	96	306	96
5	Tod Hwy	Murdinga Stn	Tooligie Stn	240	40	28	268	68	0	19	0	0	2	0	0	285	85	266	66
6	Tod Hwy	Tooligie Stn	Yeelanna Stn	240	40	30	270	70	0	32	0	0	3	0	0	299	99	267	67
7	Tod Hwy	Yeelana Stn	Cummins	610	110	34	644	144	0	57	0	0	6	0	0	695	195	638	138
8	Tod Hwy	Cummins	Edillilie	910	260	66	976	326	0	21	0	0	7	0	0	990	340	969	319
9	Tod Hwy	Edillilie	Flinders Hwy	760	190	68	828	258	0	0	0	0	7	0	0	821	251	821	251
10	Flinders Hwy	Flinders Hwy	Western Approach Road	2170	290	68	2238	358	0	0	0	0	45	0	0	2193	313	2193	313
11	Cleve Rd	Kimba	Mangalo Road	250	60	8	258	68	0	0	0	0	0	0	0	258	68	258	68
12	Cleve Rd	Mangalo Road	Cleve	410	60	8	418	68	0	0	0	0	0	2	2	418	68	418	68
13	Unnamed Road	Waddikee	Balumbah-Kinnard Rd	200	30	2	202	32	0	0	0	0	0	0	0	202	32	202	32
14	Balumbah-Kinnard Rd	Road	Darke Peak	200	30	2	202	32	0	0	0	0	0	0	0	202	32	202	32
15	Balumbah-Kinnard Rd	Darke Peak	Kielpa	200	30	4	204	34	0	0	0	0	0	0	0	204	34	204	34
16	Balumbah-Kinnard Rd	Kielpa	Rudall	200	30	6	206	36	0	0	0	0	0	0	0	206	36	206	36
17	Balumbah-Kinnard Rd	Rudall	Lincoln Hwy	200	30	15	215	45	0	0	0	0	0	0	0	215	45	215	45
18	Birdseye Hwy	Rudall	Cleve	360	60	5	365	65	0	0	0	0	0	0	0	365	65	365	65
19	Arno Bay	Cleve	Arno Bay	420	80	13	433	93	0	0	0	0	0	0	2	431	91	431	91
20	Lincoln Hwy	Arno Bay	Balumbah-Kinnard Rd	860	150	13	873	163	24	0	4	0	0	3	11	889	155	869	155
21	Lincoln Hwy	Balumbah-Kinnard Rd	Wharminda Road	890	160	28	918	188	24	0	4	0	0	3	13	932	178	912	178
22	Wharminda Road	Wharminda	Lincoln Hwy	100	20	2	102	22	0	15	0	0	2	0	0	115	35	100	20
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	850	150	30	880	180	24	15	4	0	2	0	13	904	180	869	165
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	850	150	30	880	180	96	843	16	0	3	0	13	1803	1007	880	164
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	850	150	30	880	180	96	829	16	0	33	0	13	1759	963	850	134
24	Lincoln Hwy	Tumby Bay	Louth Bay	1620	280	30	1650	310	24	0	4	0	33	0	13	1628	264	1608	264
25a	Lincoln Hwy	Louth Bay	Richardson Road	3780	460	30	3810	490	24	0	4	0	33	0	13	3788	444	3768	444
25b	Lincoln Hwy	Richardson Road	Happy Valley Road	5050	360	30	5080	390	24	0	4	0	33	0	13	5058	344	5038	344
25c	Lincoln Hwy	Happy Valley Road	Normandy Place	8280	390	30	8310	420	24	0	4	0	33	0	13	8288	374	8268	374

`				EXISTING VOLUMES		RAIL CLOSURE IMPACT	FREIGHT STUDY BASE CASE (RAIL CLOSURE IMPACT)		PORT SPENCER IMPACT				TRIP REDISTRIBUTION - PORT LINCON TO PORT SPENCER	LUCKY BAY TRIP GENERATION	TRIP REDISTRIBUTION - PORT LINCON TO LUCKY BAY	SCENARIO 2 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)			
									FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON					FOR 8 WEEK HARVEST SEASON		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORECAST TOTAL VOLUME (AADT)	FORECAST FREIGHT VOLUME (AADT)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST FREIGHT GROWTH (AADT)	FORCAST FREIGHT REDUCTION (AADT)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
25d	Lincoln Hwy	Normandy Place	Flinders Hwy	8790	360	30	8820	390	24	0	4	0	33	0	13	8798	344	8778	344
26a	Lincoln Hwy	Flinders Hwy	New W Road	11310	410	30	11340	440	24	0	4	0	33	0	13	11318	394	11298	394
26b	Lincoln Hwy	New W Road	Porter St (Port Access)	13740	390	30	13770	420	24	0	4	0	33	0	13	13748	374	13728	374
27	Flinders Hwy	Flinders Hwy	Lincoln Hwy	3640	330	0	3640	330	0	0	0	0	0	0	0	3640	330	3640	330
28a	West Approach Road	Flinders Hwy	New W Road	1720	290	68	1788	358	0	0	0	0	45	0	0	1743	313	1743	313
28b	West Approach Road	New W Road	Pine Freezers Road	1920	420	68	1988	488	0	0	0	0	45	0	0	1943	443	1943	443
28c	West Approach Road	Pine Freezers Road	Anne Street	3430	330	68	3498	398	0	0	0	0	45	0	0	3453	353	3453	353
28d	West Approach Road	Anne Street	Mortlock Terrace	6870	360	68	6938	428	0	0	0	0	45	0	0	6893	383	6893	383
28e	West Approach Road	Mortlock Terrace	Dublin Street	11310	560	68	11378	628	0	0	0	0	45	0	0	11333	583	11333	583
28f	West Approach Road	Dublin Street	Porter St (Port Access)	6160	430	68	6228	498	0	0	0	0	45	0	0	6183	453	6183	453
	BRATTEN WAY	FLINDERS HIGHWAY	KAPINNIE	TBA	TBA	-	0	0	0	66	0	0	0	0	0	+66	+66	0	0
	BRATTEN WAY	KAPINNIE	CUMMINS	TBA	TBA	-	0	0	0	78	0	0	2	0	0	+76	+76	-2	-2
	BRATTEN WAY	CUMMIN S	Tumby Bay	300	60	-	300	60	24	501	4	0	0	0	0	825	561	304	60
	FLINDERS HIGHWAY	COFFIN BAY ROAD	TOD HWY	1300	80	-	1300	80	0	0	0	0	6	0	0	1294	74	1294	74
	FLINDERS HIGHWAY	WANGARY	COFFIN BAY ROAD	600	75	-	600	75	0	0	0	0	6	0	0	594	69	594	69
	FLINDERS HIGHWAY	WARROW ROAD	WANGARY	400	50	-	400	50	0	0	0	0	6	0	0	394	44	394	44
	FLINDERS HIGHWAY	BRATTEN WAY	WARROW ROAD	290	40	-	290	40	0	0	0	0	6	0	0	284	34	284	34
	FLINDERS HIGHWAY	ELLISTON	BRATTEN WAY	290	40	-	290	40	0	66	0	0	6	0	0	350	100	284	34
	FLINDERS HIGHWAY	WITERA	ELLISTON	330	48	-	330	48	0	58	0	0	6	0	0	382	100	324	42
	UNGRARRA ROAD	UNGARRA	LINCOLN HIGHWAY	TBA	TBA	-	0	0	0	15	0	0	2	0	0	+13	+13	-2	-2
	BIRDSEYE HWY	CLEVE	COWELL	TBA	TBA	0	0	0	0	0	0	0	0	2	0	+2	+2	+2	+2
	LINCOLN HIGHWAY	ARNO BAY	COWELL	TBA	TBA	0	0	0	0	0	0	0	0	8	4	+4	+4	+4	+4
	LINCOLN HIGHWAY	COWELL	LUCKY BAY	TBA	TBA	0	0	0	0	0	0	0	0	13	0	+13	+13	+13	+13

** ***Bold italic*** values highlight when the *Scenario 2* impact "*for 8 week harvest season"* is different to the impact *"outside harvest season"*

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

4.4.3 Scenario 3: Trip Redistribution from Port Lincoln to both Port Spencer (and Lucky Bay) with Peak Trip Generation, and east-west trip redistribution via other unsealed routes

It is noted that Council have raised concerns of the suitability of Bratten Way between Cummins and Tumby Bay to handle the increase in number of freight vehicles forecast to travel along Bratten Way.

It is recognised that the existing geometry of this section of the Bratten Way is undesirable for the anticipated increase in heavy vehicles. Although the Eyre Peninsula Local Government Association currently imposes Restricted Access Heavy Vehicle speed restrictions on the both sealed and unsealed Council roads, it is also recognised that this restriction is unlikely to deter heavy vehicle operators from using alternate east-west Council roads to access the new Port Spencer grain port, or other grain ports across the Eyre Peninsula.

For this reason, sensitivity testing has been undertaken to explore the impact of alternate east-west trip redistributions.

This is also reflected in the Eyre Peninsula *2019 Regional Transport Strategy* (SMEC, 2019), which identifies alternate east-west unsealed Council roads between Tod Highway and Lincoln Highway that have the potential in benefiting from sealed upgrades for the grain freight through the central Eyre region to Cape Hardy (another grain port facility currently proposed on the Spencer Gulf, which like Port Spencer is located between Port Neil and Tumby Bay, approximately 10 km north-east of Port Spencer) via:

- Glover Road / Ungarra-Yeelanna Road / Lipson-Ungarra Road (connection to Lincoln Highway south of Lipson Cove Road)
- Barnes Hill Road / Richardson Road / West Dog Fence Road / Ungarra-Yeelanna Road / East Dog Fence Road (connection to Lincoln Highway north of Lipson Cove Road)
- Procter Road / Brooker Road / Wharminda Road (connection to Lincoln Highway north of Lipson Cove Road)

Refer to Figure 28 for the location of these alternate unsealed east-west Council roads between Tod Highway and Lincoln Highway.

It is also recognised that the catchment analysis considered as part of this assessment considers the trip redistribution from historic grain receival locations, and is not reflective of the true grain origins due to limitations of the data available. As such, it is expected that these unsealed Council roads (which form part of the Grain Commodity restricted access network for road trains) may be used by some grain freight operators travelling to Port Spencer instead of travelling solely via the gazetted restricted access network for GML and HML 36.5 m road trains (as considered for Scenarios 1 and 2).

Alternate east-west trip redistributions to Port Spencer via Bratten Way (as considered for Scenario 2) has been considered for this sensitivity testing such that:

a) 100% of CVs travel via the above identified alternate east-west unsealed Council roads (equally distributed along each of the three routes)

b) 50% of CVs travel via the above identified alternate east-west unsealed Council roads (equally distributed along each of the three routes), and 50% via Bratten Way.

The localised impact to the road freight network (including the above identified unsealed Council roads) is tabulated in Table 6 and Table 7 on the following pages.

As demonstrated below, consideration of alternate east-west links between Tod Highway and Lincoln Highway could significantly reduce the freight traffic impact along Bratten Way between Cummins and Tumby Bay. The impact to the unsealed Council roads could be up to +501 CVs during a peak harvest season day.

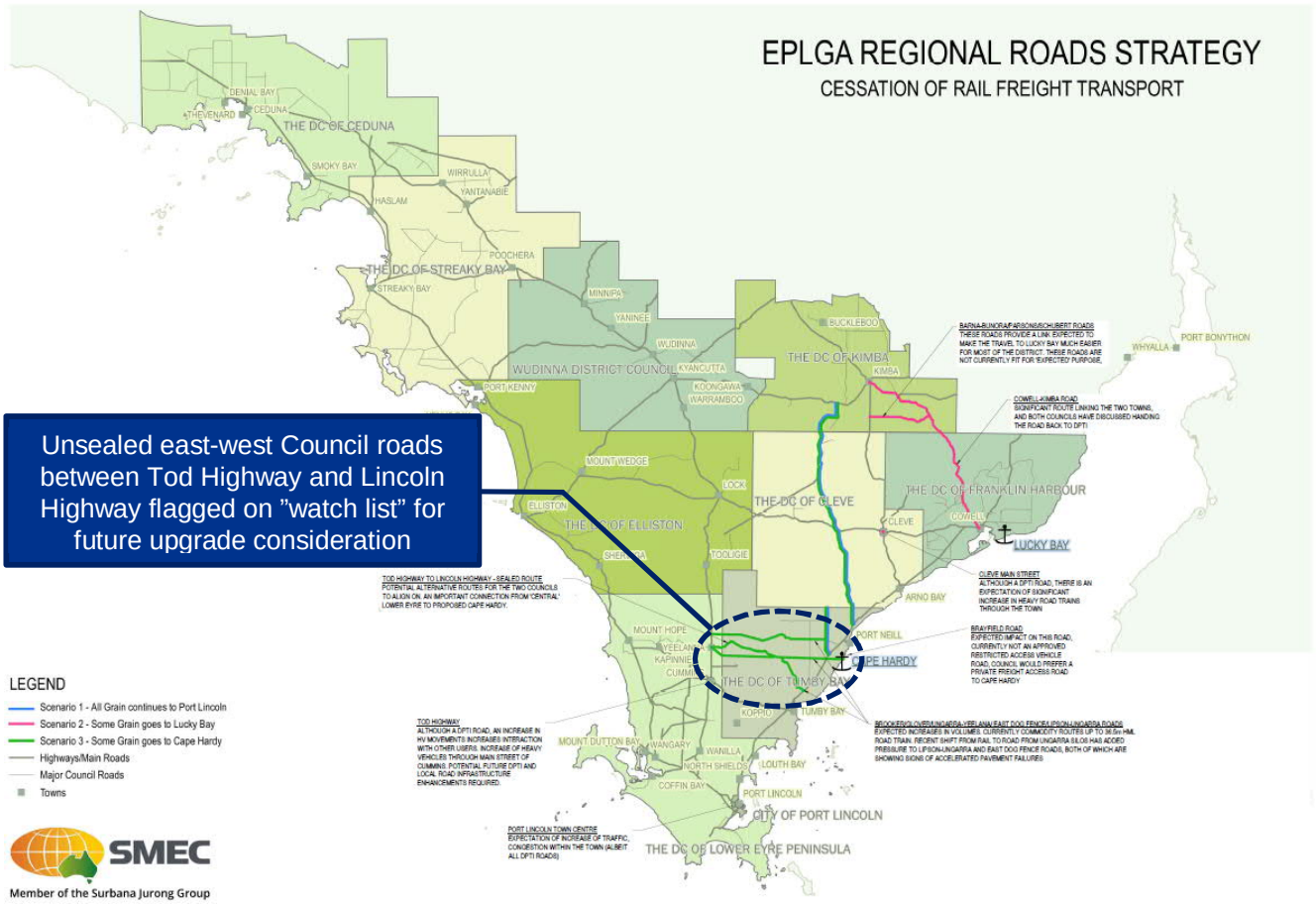

Figure 28: 2019 Regional Transport Strategy – identified unsealed east-west Council roads between Tod Highway and Lincoln Highway flagged on a "watch list" for future upgrade consideration (SMEC, 2019)

It is recognised that this impact may be shared across multiple unsealed (and sealed) east-west links (as shown below), or could be felt across a single east-west unsealed Council road link. This is greatly dependent on the driver behaviours of heavy vehicle (grain) operators, which is difficult to predict given the large number of recent changes that have occurred for this grain region. This includes the uncertainty regarding the level of impact of the future ports along the Spencer Gulf coastline, as acknowledged by the *2019 Regional Transport Strategy*, and the potential change of the role and function of the local road network (reduced reliance of upstream inland grain storage sites), which has resulted in these unsealed roads being flagged on a "watch list" for consideration moving forward as part of the strategy.

Feedback received from Councils as part of the Technical Working Group engagement by Peninsula Ports for the Port Spencer development has indicated a likely preference for a new sealed east-west link along the Dog Fence Road route. In its current state, this (Dog Fence Road route) and the other identified east-west unsealed Council road links may not be suited for the potential east-west freight volume increases that may result from this development, and other grain port developments in the area (i.e. Cape Hardy, which has not been considered specifically as part of this assessment) if these freight volume increases were to be concentrated along these routes.

Due to these unknowns for future driver behaviour, it is recommended that these unsealed Council roads be monitored for future east-west freight volume increases to inform any new future strategic east-west freight link upgrades.

Note that Wharminda Road and Balumbah-Kinnard Road were also identified on the "watch list" for future upgrade consideration as part of the *2019 Regional Transport Strategy*, however, as these roads are noted as being impacted by the railway line closure (i.e. all grain continues to Port Lincoln) and not solely as a result of the new export ports proposed along the Spencer Gulf coastline, these routes were considered as part of the *New Baseline Transport Situation* (and subsequent trip redistributions for *Scenarios 1* and *2*).

Table 6: Indicative forecast volumes across key road links on the Eyre Peninsula for Scenario 3a (100% of CVs travel via the unsealed east-west road network with Peak Trip Generation)

				PORT SPENCER IMPACT		SCENARIO 3a IMPACT (100% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)	
				FOR 8 WEEK HARVEST SEASON - PEAK		FOR 8 WEEK HARVEST SEASON - PEAK	
SEGMENT ID	ROAD	FROM	TO	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
	Procter Road / Brooker Road	Tod Highway	Wharminda	0	0 + (501/3) = 167	+167	+167
22	Wharminda Road	Wharminda	Lincoln Hwy	0	15 + (501/3) = 182	282	202
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	24	15 + (501/3) = 182	1071	347
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	96	843 – (501/3) = 676	1636	840
	Barnes Hill Road / Richardson Road / West Dog Fence Road / Ungarra-Yeelanna Road / East Dog Fence Road	Tod Highway	Lincoln Highway	0	0 + (501/3) = 167	+167	+167
	Glover Road / Ungarra-Yeelanna Road	Tod Highway	Ungarra	0	0 + (501/3) = 167	+167	+167
	UNGRARRA ROAD	UNGARRA	LINCOLN HIGHWAY	0	15 + (501/3) = 182	+180	+180
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	96	829 – (501) = 328	1258	462
	BRATTEN WAY	CUMMIN S	Tumby Bay	24	501 – (501) = 0	324	60

* Changes from Scenario 2 are noted by ***Bold Italics***

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

Table 7: Indicative forecast volumes across key road links on the Eyre Peninsula for Scenario 3b (50% of CVs travel via the unsealed east-west road network with Peak Trip Generation)

				PORT SPENCER IMPACT		SCENARIO 3b IMPACT (50% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)	
				FOR 8 WEEK HARVEST SEASON - PEAK		FOR 8 WEEK HARVEST SEASON - PEAK	
SEGMENT ID	ROAD	FROM	TO	FORECAST LV GROWTH (DAILY)	FORECAST FREIGHT GROWTH (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
	Procter Road / Brooker Road	Tod Highway	Wharminda	0	0 + ([501/2]/3) = 84	+84	+84
22	Wharminda Road	Wharminda	Lincoln Hwy	0	15 + ([501/2]/3) = 99	199	119
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	24	15 + ([501/2]/3) = 99	988	264
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	96	843 – ([501/2]/3) = 759	1719	923
	Barnes Hill Road / Richardson Road / West Dog Fence Road / Ungarra-Yeelanna Road / East Dog Fence Road	Tod Highway	Lincoln Highway	0	0 + ([501/2]/3) = 84	+84	+84
	Glover Road / Ungarra-Yeelanna Road	Tod Highway	Ungarra	0	0 + ([501/2]/3) = 84	+84	+84
	UNGRARRA ROAD	UNGARRA	LINCOLN HIGHWAY	0	15 + ([501/2]/3) = 99	+97	+97
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	96	829 – (501/2) = 579	1508	712
	BRATTEN WAY	CUMMINS	Tumby Bay	24	501 – (501/2) = 250	574	310

* Changes from Scenario 2 are noted by ***Bold Italics***

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

4.4.4 Summary of Scenarios

The table following summaries the indictive forecast impact of the Port Spencer development across key road links on the Eyre Peninsula.

Table 8: Summary of the indicative forecast volumes across key road links on the Eyre Peninsula for all scenarios

				WITHOUT PORT SPENCER				WITH PORT SPENCER															
								CONSIDERS UNIFORM DISTRIBUTION EACH DAY OVER HARVEST (AVERAGE)				CONSIDERS PEAK 30,000 TONNE HARVEST RECIVALS DAY											
				EXISTING VOLUMES		NEW BASELINE TRANSPORT SITUATION (FREIGHT STUDY BASE CASE + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)		SCENARIO 1 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 2 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 3a IMPACT (same as Scenario 2 except with 100% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)				SCENARIO 3a IMPACT (same as Scenario 2 except with 50% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)			
								FOR 8 WEEK HARVEST SEASON - UNIFORM		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
1	Eyre Hwy	Wudinna Stn	Kyancutta Stn	1010	300	1020	310	1020	310	1020	310	1020	310	1020	310	1020	310	1020	310	1020	310	1020	310
2	Tod Hwy	Kyancutta Stn	Warramboo Stn	250	70	264	84	264	84	264	84	264	84	264	84	264	84	264	84	264	84	264	84
3	Tod Hwy	Warramboo Stn	Lock Stn	260	90	276	106	276	106	276	106	276	106	276	106	276	106	276	106	276	106	276	106
4	Tod Hwy	Lock Stn	Murdinga Stn	280	70	309	99	306	96	306	96	306	96	306	96	306	96	306	96	306	96	306	96
5	Tod Hwy	Murdinga Stn	Tooligie Stn	240	40	268	68	277	77	266	66	285	85	266	66	285	85	266	66	285	85	266	66
6	Tod Hwy	Tooligie Stn	Yeelanna Stn	240	40	267	67	286	86	267	67	299	99	267	67	299	99	267	67	299	99	267	67
7	Tod Hwy	Yeelana Stn	Cummins	610	110	641	141	673	173	638	138	695	195	638	138	695	195	638	138	695	195	638	138
8	Tod Hwy	Cummins	Edillilie	910	260	938	288	982	332	969	319	990	340	969	319	990	340	969	319	990	340	969	319
9	Tod Hwy	Edillilie	Flinders Hwy	760	190	788	218	821	251	821	251	821	251	821	251	821	251	821	251	821	251	821	251
10	Flinders Hwy	Flinders Hwy	Western Approach Road	2170	290	2198	318	2193	313	2193	313	2193	313	2193	313	2193	313	2193	313	2193	313	2193	313
11	Cleve Rd	Kimba	Mangalo Road	250	60	258	68	258	68	258	68	258	68	258	68	258	68	258	68	258	68	258	68
12	Cleve Rd	Mangalo Road	Cleve	410	60	418	68	418	68	418	68	418	68	418	68	418	68	418	68	418	68	418	68
13	Unnamed Road	Waddikee	Balumbah-Kinnard Rd	200	30	202	32	202	32	202	32	202	32	202	32	202	32	202	32	202	32	202	32
14	Balumbah-Kinnard Rd	Road	Darke Peak	200	30	202	32	202	32	202	32	202	32	202	32	202	32	202	32	202	32	202	32
15	Balumbah-Kinnard Rd	Darke Peak	Kielpa	200	30	204	34	204	34	204	34	204	34	204	34	204	34	204	34	204	34	204	34
16	Balumbah-Kinnard Rd	Kielpa	Rudall	200	30	206	36	206	36	206	36	206	36	206	36	206	36	206	36	206	36	206	36
17	Balumbah-Kinnard Rd	Rudall	Lincoln Hwy	200	30	215	45	215	45	215	45	215	45	215	45	215	45	215	45	215	45	215	45
18	Birdseye Hwy	Rudall	Cleve	360	60	374	74	365	65	365	65	365	65	365	65	365	65	365	65	365	65	365	65
19	Arno Bay	Cleve	Arno Bay	420	80	431	91	431	91	431	91	431	91	431	91	431	91	431	91	431	91	431	91
20	Lincoln Hwy	Arno Bay	Balumbah-Kinnard Rd	860	150	933	223	889	155	869	155	889	155	869	155	889	155	869	155	889	155	869	155
21	Lincoln Hwy	Balumbah-Kinnard Rd	Wharminda Road	890	160	976	246	932	178	912	178	932	178	912	178	932	178	912	178	932	178	912	178
22	Wharminda Road	Wharminda	Lincoln Hwy	100	20	102	22	109	29	100	20	115	35	100	20	282	202	100	20	199	119	100	20
23	Lincoln Hwy	Wharminda Road	PORT SPENCER	850	150	934	234	898	174	869	165	904	180	869	165	1071	347	869	165	988	264	869	165
	Lincoln Hwy	PORT SPENCER	UNGARRA ROAD	850	150	934	234	1470	674	880	164	1803	1007	880	164	1636	840	880	164	1719	923	880	164

				WITHOUT PORT SPENCER				WITH PORT SPENCER													
								CONSIDERS UNIFORM DISTRIBUTION EACH DAY OVER HARVEST (AVERAGE)				CONSIDERS PEAK 30,000 TONNE HARVEST RECIVALS DAY									
				EXISTING VOLUMES		NEW BASELINE TRANSPORT SITUATION (FREIGHT STUDY BASE CASE + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)		SCENARIO 1 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 2 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 3a IMPACT (same as Scenario 2 except with 100% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)				SCENARIO 3a IMPACT (same as Scenario 2 except with 50% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)			
								FOR 8 WEEK HARVEST SEASON - UNIFORM		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
	Lincoln Hwy	UNGARRA ROAD	Tumby Bay	850	150	902	202	1431	635	850	134	1759	963	850	134	1258	462	850	134	1508	712	850	134
24	Lincoln Hwy	Tumby Bay	Louth Bay	1620	280	1605	265	1628	264	1608	264	1628	264	1608	264	1628	264	1608	264	1628	264	1608	264
25a	Lincoln Hwy	Louth Bay	Richardson Road	3780	460	3765	445	3788	444	3768	444	3788	444	3768	444	3788	444	3768	444	3788	444	3768	444
25b	Lincoln Hwy	Richardson Road	Happy Valley Road	5050	360	5035	345	5058	344	5038	344	5058	344	5038	344	5058	344	5038	344	5058	344	5038	344
25c	Lincoln Hwy	Happy Valley Road	Normandy Place	8280	390	8265	375	8288	374	8268	374	8288	374	8268	374	8288	374	8268	374	8288	374	8268	374
25d	Lincoln Hwy	Normandy Place	Flinders Hwy	8790	360	8775	345	8798	344	8778	344	8798	344	8778	344	8798	344	8778	344	8798	344	8778	344
26a	Lincoln Hwy	Flinders Hwy	New W Road	11310	410	11295	395	11318	394	11298	394	11318	394	11298	394	11318	394	11298	394	11318	394	11298	394
26b	Lincoln Hwy	New W Road	Porter St (Port Access)	13740	390	13725	375	13748	374	13728	374	13748	374	13728	374	13748	374	13728	374	13748	374	13728	374
27	Flinders Hwy	Flinders Hwy	Lincoln Hwy	3640	330	3640	330	3640	330	3640	330	3640	330	3640	330	3640	330	3640	330	3640	330	3640	330
28a	West Approach Road	Flinders Hwy	New W Road	1720	290	1742	312	1743	313	1743	313	1743	313	1743	313	1743	313	1743	313	1743	313	1743	313
28b	West Approach Road	New W Road	Pine Freezers Road	1920	420	1942	442	1943	443	1943	443	1943	443	1943	443	1943	443	1943	443	1943	443	1943	443
28c	West Approach Road	Pine Freezers Road	Anne Street	3430	330	3452	352	3453	353	3453	353	3453	353	3453	353	3453	353	3453	353	3453	353	3453	353
28d	West Approach Road	Anne Street	Mortlock Terrace	6870	360	6892	382	6893	383	6893	383	6893	383	6893	383	6893	383	6893	383	6893	383	6893	383
28e	West Approach Road	Mortlock Terrace	Dublin Street	11310	560	11332	582	11333	583	11333	583	11333	583	11333	583	11333	583	11333	583	11333	583	11333	583
28f	West Approach Road	Dublin Street	Porter St (Port Access)	6160	430	6182	452	6183	453	6183	453	6183	453	6183	453	6183	453	6183	453	6183	453	6183	453
	BRATTEN WAY	FLINDERS HIGHWAY	KAPINNIE	TBA	TBA	0	0	+40	+40	0	0	+66	+66	0	0	+66	+66	0	0	+66	+66	0	0
	BRATTEN WAY	KAPINNIE	CUMMINS	TBA	TBA	0	0	+46	+46	-2	-2	+76	+76	-2	-2	+76	+76	-2	-2	+76	+76	-2	-2
	BRATTEN WAY	CUMMINS	Tumby Bay	300	60	337	97	627	363	304	60	825	561	304	60	324	60	304	60	574	310	304	60
	FLINDERS HIGHWAY	COFFIN BAY ROAD	TOD HWY	1300	80	1294	74	1294	74	1294	74	1294	74	1294	74	1294	74	1294	74	1294	74	1294	74
	FLINDERS HIGHWAY	WANGARY	COFFIN BAY ROAD	600	75	594	69	594	69	594	69	594	69	594	69	594	69	594	69	594	69	594	69
	FLINDERS HIGHWAY	WARROW ROAD	WANGARY	400	50	394	44	394	44	394	44	394	44	394	44	394	44	394	44	394	44	394	44
	FLINDERS HIGHWAY	BRATTEN WAY	WARROW ROAD	290	40	284	34	284	34	284	34	284	34	284	34	284	34	284	34	284	34	284	34
	FLINDERS HIGHWAY	ELLISTON	BRATTEN WAY	290	40	284	34	324	74	284	34	350	100	284	34	350	100	284	34	350	100	284	34

				WITHOUT PORT SPENCER				WITH PORT SPENCER															
								CONSIDERS UNIFORM DISTRIBUTION EACH DAY OVER HARVEST (AVERAGE)				CONSIDERS PEAK 30,000 TONNE HARVEST RECIVALS DAY											
				EXISTING VOLUMES		NEW BASELINE TRANSPORT SITUATION (FREIGHT STUDY BASE CASE + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)		SCENARIO 1 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 2 IMPACT (FREIGHT STUDY BASE CASE + TRIP GENERATION TO PORT SPENCER – TRIP REDISTRIBUTION FROM PORT LINCOLN TO PORT SPENCER + TRIP GENERATION TO LUCKY BAY – TRIP REDISTRIBUTION FROM PORT LINCOLN TO LUCKY BAY)				SCENARIO 3a IMPACT (same as Scenario 2 except with 100% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)				SCENARIO 3a IMPACT (same as Scenario 2 except with 50% OF CVS TRAVEL VIA THE UNSEALED EAST-WEST ROAD NETWORK WITH PEAK TRIP GENERATION)			
								FOR 8 WEEK HARVEST SEASON - UNIFORM		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON		FOR 8 WEEK HARVEST SEASON - PEAK		OUTSIDE HARVEST SEASON	
SEGMENT ID	ROAD	FROM	TO	CURRENT TOTAL VOLUME (AADT)	CURRENT FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)	FORECAST TOTAL VOLUME (DAILY)	FORECAST FREIGHT VOLUME (DAILY)
	FLINDERS HIGHWAY	WITERA	ELLISTON	330	48	330	48	359	77	324	42	382	100	324	42	382	100	324	42	382	100	324	42
	UNGARRA ROAD	UNGARRA	LINCOLN HIGHWAY	TBA	TBA	0	0	+7	+7	-2	-2	+13	+13	-2	-2	+180	+180	-2	-2	+97	+97	-2	-2
	BIRDSEYE HWY	CLEVE	COWELL	TBA	TBA	+12	+12	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2
	LINCOLN HIGHWAY	ARNO BAY	COWELL	TBA	TBA	+73	+73	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4	+4
	LINCOLN HIGHWAY	COWELL	LUCKY BAY	TBA	TBA	+90	+90	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13	+13
	PROCTER ROAD / BROOKER ROAD	TOD HIGHWAY	WHARMINDA	TBA	TBA	0	0	0	0	0	0	0	0	0	0	+167	+167	0	0	+84	+84	0	0
	BARNES HILL ROAD / RICHARDSON ROAD / WEST DOG FENCE ROAD / UNGARRA-YEELANNA ROAD / EAST DOG FENCE ROAD	TOD HIGHWAY	LINCOLN HIGHWAY	TBA	TBA	0	0	0	0	0	0	0	0	0	0	+167	+167	0	0	+84	+84	0	0
	GLOVER ROAD / UNGARRA-YEELANNA ROAD	TOD HIGHWAY	UNGARRA	TBA	TBA	0	0	0	0	0	0	0	0	0	0	+167	+167	0	0	+84	+84	0	0

* Coloured cells highlight change in volume when compared to the previous scenario during the "*8 Week Harvest Season"*

** ***Bold italic*** values highlight change in volume when compared to the *New Baseline Transport Situation*

*** Red text highlights rows where existing volumes were not available, and impact is measured as a relative increase "+" or decrease "-"

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5. Projected Construction Traffic

5.1 Assumptions

It should be noted that this traffic impact assessment has been undertaken early in the planning phase of this project.

This initial traffic assessment is therefore based on the assumptions as detailed in the sections following, which considers a combination of initial information as provided by Peninsula Ports and other consultants, other publicly available sources, and the professional judgement of the author, with consideration made of the original development assessment assumptions considered.

5.2 Construction Traffic Generation

Note: It is noted that the current design development envisages all bulk earthworks and rock being site won, significantly reducing the bulk materials haul task and therefore construction traffic impact. The scale of the development is significantly lower in terms of oversized and heavy materials deliveries comparative to the previous Centrex proposal.

Construction of the site is expected to take approximately 12- 13 months in total, broadly categorised into four phases as follows:

- Phase 1 – Site Mobilisation (Month 1)
- Phase 2 – Shipment Deliveries (Months 2 – 3)
- Phase 3 – Landside civil works, roads, access tracks and foundations (Months 2 – 12)
- Phase 4 – Portside works (Months 2 – 12)
- Phase 5 – Site Demobilisation (Months 12 – 13).

The majority of construction traffic movements, as estimated based on the information provided by the ECI Contractors and Peninsula Ports, are envisaged to occur between Month 2 (which will see a combination of traffic movements associated from Phases 1, 2, 3 and 4 as a result of construction activities including the delivery of construction materials and equipment), or Months 10 – 11 (which will see a combination of traffic movements associated from Phases 2, 3 and 4 predominately associated with the construction labour force).

An estimation of the construction labour force (personnel per day) has been considered as the basis for the assumed staff and labour contractor movements during construction, based on the information provided by ECI Contractors and Peninsula Ports. Approximately 150 construction staff and labourers are estimated to be located on site each day during the peak construction period, all assumed to be transported to site via a combination of 24 seater buses, 12-seater buses and other light vehicles (refer Appendix B for additional detail of the staff and contractor vehicle movement estimation over the construction period).

It was assumed that the construction will be undertaken over 13 day fortnights (every second Sunday off) with day and night shift construction works.

The estimated construction vehicle trip movements are detailed in the tables following.

Note: An increase of 10% has been applied by Jacobs to the estimated one-way trips for construction vehicles listed in the tables below (see Revised Estimated Total trips (one-way) column). This is to allow for any unforeseen increases in trip movements during the construction phase and to account for potential variations in the development of the project in detailed design.

Table 9: Estimated Total Construction Traffic for Construction Materials

Components	Estimated Total Construction Traffic for Construction Materials		
	ECI Estimated Total Trips (One-way Vehicle Trips)	Revised Estimated Total Trips (One-way Vehicle Trips)	Vehicle Type
China Fabricated Items (Shipping Deliveries)			
Piles - 35m	10	11	OD Vehicle
Piles - 40m	10	11	OD Vehicle
Anchors	7	8	19m Semi-trailer
Launching beams	16	18	OD Vehicle
Transverse Brace beams	10	11	19m Semi-trailer
Diagonal braces beams	8	9	19m Semi-trailer
Braced Frame - Verticals	14	16	19m Semi-trailer
Braced Frame - Horizontals	5	6	19m Semi-trailer
Braced Frame - Diagonal	3	3	19m Semi-trailer
Headstock	1	1	19m Semi-trailer
Precast Concrete - Roadway	48	53	19m Semi-trailer
Precast Concrete - Service Platform	12	13	19m Semi-trailer
Mooring Dolphin Platform	1	1	19m Semi-trailer
Mooring Dolphin walkway	1	1	19m Semi-trailer
Other Construction Materials			
Grout	4	4	19m Semi-trailer
Electrical supplies and lighting	2	2	19m Semi-trailer
Mech services and piping	2	2	19m Semi-trailer
Fenders	4	4	19m Semi-trailer
Fender plates	1	1	19m Semi-trailer
Fender Chains	1	1	19m Semi-trailer
Tugger winches	1	1	19m Semi-trailer
QRH	2	2	19m Semi-trailer
General Deliverables (1 per week)	37	41	19m Semi-trailer
Crane Rail	3	3	19m Semi-trailer
Temporary Works	10	11	19m Semi-trailer
**additional 20% allowance*	36	40	19m Semi-trailer
	8	9	OD Vehicle
Other Construction Vehicles			
Escort Vehicles	73	80	Light Vehicles
**additional 20% allowance*	15	17	Light Vehicles
Total Light Vehicle Movements (one-way)	**88**	**97**	**Car / Light Vehicles**

Components	Estimated Total Construction Traffic for Construction Materials		
	ECI Estimated Total Trips (One-way Vehicle Trips)	Revised Estimated Total Trips (One-way Vehicle Trips)	Vehicle Type
Total Heavy Commercial Vehicle (HCV) Movements (one-way)	**213, split** **- Shipping Deliveries = 131** **- Other Construction Materials = 82**	**234, split:** **- Shipping Deliveries = 144** **- Other Construction Materials = 90**	**HCVs** ***(If 60% B-Doubles are used the total one-way trips is 165)***
Total Over-Dimensional (OD) Vehicle Movements (one-way)	**44**	**49**	**OD Vehicles**

Table 10: Estimated Total for Construction Staff and Work Site Activity

Components	Estimated Total for Construction Staff and Work Site Activity		
	ECI Estimated Total Trips (One-way Vehicle Trips)	Revised Estimated Total Trips (One-way Vehicle Trips)	Vehicle Type
Site Mobilisation			
Piling Hammer	1	1	19m Semi-trailer
Drill	4	4	19m Semi-trailer
Compressors	5	6	19m Semi-trailer
Drill powerpack	1	1	19m Semi-trailer
Vibro Hammer	1	1	19m Semi-trailer
Favco Crane	20	22	19m Semi-trailer
400t Crawler Crane	14	16	19m Semi-trailer
8t slewing crane	1	1	19m Semi-trailer
Site Offices (12m)	14	16	19m Semi-trailer
Water tanks	1	1	19m Semi-trailer
Storage containers	4	4	19m Semi-trailer
Grout Spread	1	1	19m Semi-trailer
Generators	1	1	19m Semi-trailer
**additional 20% allowance*	*14*	*15*	*19m Semi-trailer*
Staff and Contractors *(*two-way movements considered)*	1,694 x 24 seater buses *(Peak day = 4 Heavy Vehicles during months 10 and 11)*	1,864 x 24 seater buses *(Peak day = 5 Heavy Vehicles during months 10 and 11)*	1,864 x Heavy Vehicles
	1,858 x 12 seater buses 736 x Light Trucks 24,303 x other light vehicles *(Peak day = 135 Light Vehicles during months 10 and 11)*	2,044 x 12 seater buses 810 x Light Trucks 26,734 x other light vehicles *(Peak day = 149 Light Vehicles during months 10 and 11)*	26,897 x Light Vehicles

Components	Estimated Total for Construction Staff and Work Site Activity		
	ECI Estimated Total Trips (One-way Vehicle Trips)	Revised Estimated Total Trips (One-way Vehicle Trips)	Vehicle Type
Site Demobilisation			
Piling Hammer	1	1	19m Semi-trailer
Drill	4	4	19m Semi-trailer
Compressors	5	6	19m Semi-trailer
Drill powerpack	1	1	19m Semi-trailer
Vibro Hammer	1	1	19m Semi-trailer
Favco Crane	20	22	19m Semi-trailer
400t Crawler Crane	14	16	19m Semi-trailer
8t slewing crane	1	1	19m Semi-trailer
Site Offices (12m)	14	16	19m Semi-trailer
Water tanks	1	1	19m Semi-trailer
Storage containers	4	4	19m Semi-trailer
Grout Spread	1	1	19m Semi-trailer
Generators	1	1	19m Semi-trailer
**additional 20% allowance*	*14*	*15*	*19m Semi-trailer*
Total Light Vehicle Movements (*two-way)	1,858 two-way vehicle movements for bussing of construction staff. 24,303 two-way light vehicle movements. 736 two-way light truck movements.	2,044 two-way vehicle movements for bussing of construction staff. 26,734 two-way light vehicle movements. 810 two-way light truck movements.	**Car / Light Vehicles**
Total Heavy Commercial Vehicle (HCV) Movements (*one-way & two-way)	164 one-way vehicles for site mobilisation and de-mobilisation. 1,694 two-way vehicle movements for bussing of construction staff	180 one-way vehicles for site mobilisation and de-mobilisation. 1,864 two-way vehicle movements for bussing of construction staff	**HCVs**

5.3 Construction Traffic Impact

The impact of the generated traffic has been divided into three categories:

- **Light Vehicle traffic** (e.g. 4WDs and cars) associated with staff movements to and from the site, and escort vehicles.
- **Heavy Commercial Vehicles** (e.g. >2-tonne trucks, semi-trailers, dump trucks etc.) associated with deliveries to site during construction and operation that will travel on roads according to the current gazettal's.
- **Over Dimensional and Over Mass Vehicles** associated with transportation of construction materials to site that may only travel under NHVR and DPTI permit.

To evaluate impacts of generated traffic on the capacity of the adjacent road system, the estimated trips from Section 5.2 have been converted to daily traffic volumes in each category in the table below. Consideration has been made to the differing peak periods during construction; for the delivery of construction materials, and for the peak workforce.

Table 11: Traffic generated during construction (using revised generation)

Vehicle Type	Total Generated Traffic	During Peak Construction Material Delivery Period (Month 2)		During Peak Construction Workforce Period (Months 10 – 11)	
		Total Traffic (1 month = 31 days)	Daily Traffic	Total Traffic (2 months = 61 days)	Daily Traffic
Light Vehicles	(97 * 2) + [2,044 + 26,734 + 810] = 29,781	(97 * 2) + [1,554 + 10%] = (194) + [1,710] = 1,904	(6 * 2) + [51 + 10%] = (12) + [56] = 68 trips/day	[8,157 + 10%] = 8,973	[135 + 10%] = 149 trips/day
Heavy Commercial Vehicles (HCVs)	(234 * 2) + [(180 * 2) + 1,864] = 2,692	[(80 + 45) * 2] + [115 + 10%] = 377	[(5 * 2) + 4] + [4 + 10%] = 19 trips/day	[227 + 10%] = 250	[4 + 10%] = 5 trips/day
Over-Dimensional (OD) Vehicles	(49 * 2) + [0] = 98	50	(3 * 2) = 6 trips/day	-	-

Note:

- An increase of 10% was applied by Jacobs to the estimated one-way vehicle trips for construction vehicles (as listed in the tables above) to allow for any unforeseen increases in trip movements during the construction phase.
- It is assumed (as a worst case):

During Peak Construction Material Delivery Period (Months 2)

One shipping delivery to occur during this period to Whyalla (note that in total, two shipping deliveries are expected for the China Fabricated items into Whyalla during construction – the second will occur during Month 3). On each shipment 80 trailers loads are assumed to be required to transport each shipment, with an 5 deliveries per day (over a duration of 16 days). 2-3 OD loads will be required every day during this delivery period.

Other construction materials are to be delivered to site early during the construction period (with deliveries arriving 2 weeks after site mobilisation commences) – 50% of trips assumed to occur during Month 2.

During Peak Construction Workforce Period (Months 10 – 11)

All construction materials and equipment are already located on site, as such, construction traffic related to staff and construction labour workforce transport only (refer Appendix B for the assumed trip generation by staff and construction labour workforce transport from Team A).

- A 6.5 day working week (i.e. 13 working days per fortnight) has been assumed.
- Each OD vehicle will also be accompanied by two pilot vehicles.

Note that the generated daily trips reflect two-way vehicle movements (i.e. one trip for vehicles travelling to site and one trip for vehicles travelling from site) for comparison to the current daily traffic volumes on each approach road being considered for providing access to the site. These are the Lipson Cove Road (providing direct site access) and Lincoln Highway (providing connection to Lipson Cove Road).

Table 12: Traffic impact along key road links in vicinity of the site

	Lipson Cove Road		Lincoln Highway	
	During Peak Construction Material Delivery Period (Month 2)	**During Peak Construction Workforce Period (Months 10 – 11)**	**During Peak Construction Material Delivery Period (Month 2)**	**During Peak Construction Workforce Period (Months 10 – 11)**
Traffic Volume	50 Annual Average Daily Traffic (AADT)		934 AADT (*New Baseline Transport Situation* volume between Ungarra Road and Wharminda Road)	
HCV Volume	5 AADT (10.0% of total)		234 AADT (25.1% of total) (*New Baseline Transport Situation* volume between Ungarra Road and Wharminda Road)	
Generated Traffic	68 + 19 + 6 = 93 trips/day	149 + 5 = 154 trips/day	93 trips/day	154 trips/day
Generated HCVs (including OD Vehicles)	19 + 6 = 25 trips/day	5 trips/day	25 trips/day	5 trips/day
TOTAL Traffic	143 trips/day	204 trips/day	1,027 trips/day	1,088 trips/day
TOTAL HCVs	30 trips/day (21.0%)	10 trips/day (4.9%)	259 trips/day (25.2%)	239 trips/day (22.0%)
Traffic Increase	+186%	+308%	+10.0%	+16.5%
HCV Increase	+500%	+100%	+10.7%	+2.1%

From a traffic capacity viewpoint, the peak construction traffic impact of the proposal is considered to be minimal. With total two-way daily traffic volumes of up to 204 trips per day on Lipson Cove Road and up to 1,088 trips per day on Lincoln Highway during construction, the adjoining access roads will continue to operate at Level of Service (LOS) “A” (i.e. uncongested) with construction traffic. The OD vehicles will operate under pilot and may be pulled over when necessary to minimise traffic delay.

6. Findings and Recommendations

6.1 Site Access

The site is proposed to operate with separate entry and exit access points from Lipson Cove Road, with provision for heavy vehicle queueing areas (waiting bays) on-site.

The site access arrangement has been developed to eliminate the number of vehicle conflict points (opposing turn movements), and contains all major internal heavy vehicle circulation movements on-site.

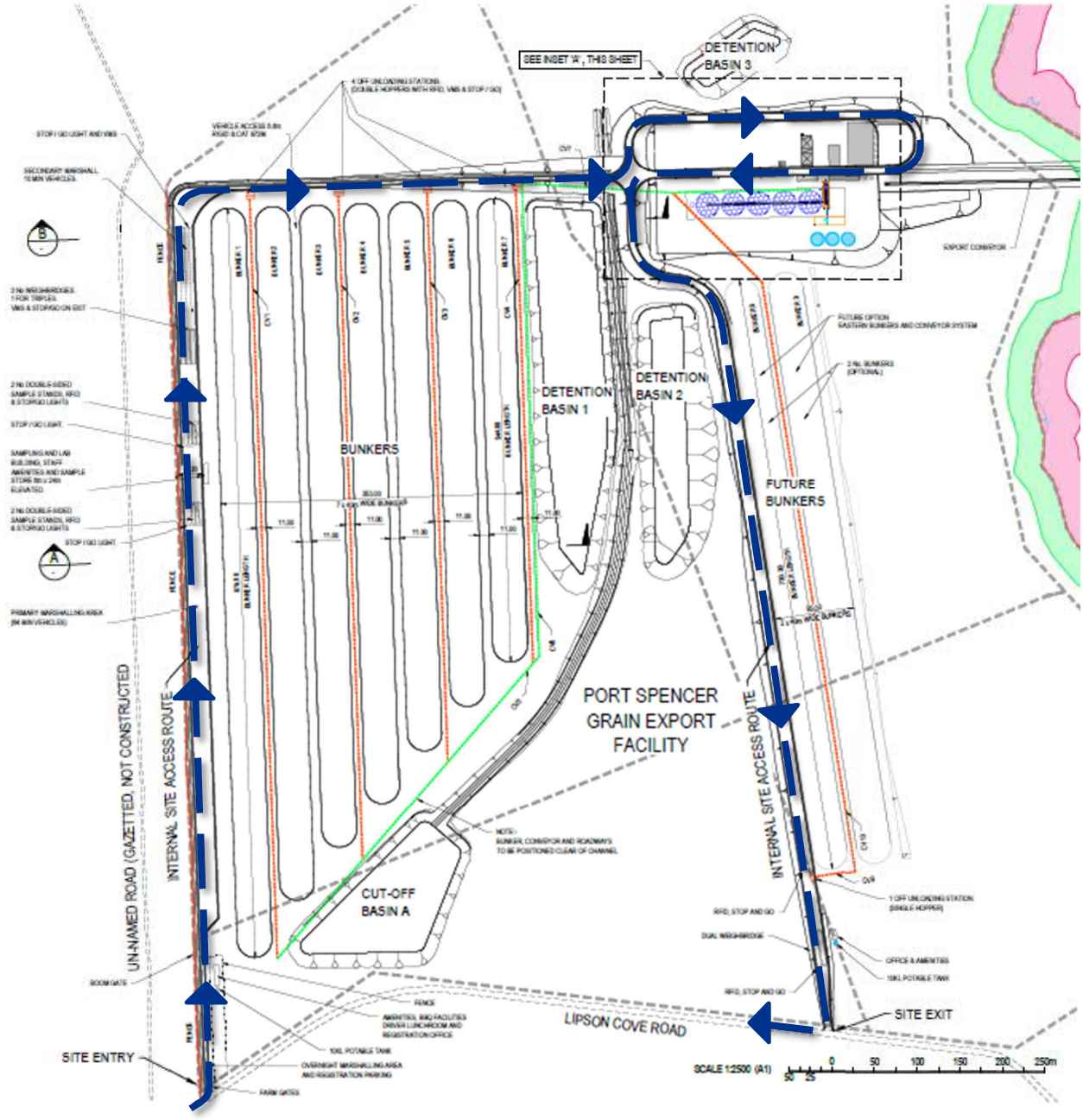


Figure 29: Port Spencer site access arrangement from Lipson Cove Road with indicative internal site circulation (blue dashed line)

Due to the existing low vehicle volumes along Lipson Cove Road and short harvest season, provision of basic intersection treatments for the new access points are considered appropriate.

6.2 Transportation Impacts

Operation Impact

The principal issues surrounding the transportation impacts are expected to be surrounding the operations phase (for an seasonal eight-week harvest period). This is due to the higher number of vehicle movements associated with the grain receivals during this period across the wider Eyre Peninsula freight road network (this is consistent with the 'business-as-usual' operations for the region, noting the region is largely primary production grain growing lands).

Numerous factors need be considered in assessing the impact of Port Spencer on the surrounding road network, and it should be noted that several recent changes have occurred within the wider Eyre Peninsula area (i.e. railway line closure, silo closures, and opening of new export ports) which is expected to significantly change travel patterns and redistribute freight traffic across the Eyre Peninsula. Estimations of the impact have been made, but as there is a level of uncertainty of what the new baseline transport situation is for comparison of impact, it is difficult to ascertain the impact directly attributed to the Port Spencer development.

At Lincoln Highway, where the Port Spencer generated traffic is concentrated at the intersection with Lipson Cove Road to access the site, it is expected that on an average receivals day (i.e. 18,125 tonnes per day, over eight week harvest season) approximately 260 CVs and 60 LVs would be attracted to Port Spencer, resulting in an increase of 690 total two way movements at the intersection (or 520 two-way CV movements). Based on the catchment analysis of historic grain receivals, and assumptions as to the redistribution of harvest traffic to the new grain receival ports, up to 98 percent of CVs are assumed to approach Lipson Cove Road from Lincoln Highway south. During a peak hour, this equates to approximately 15 CVs turning right into Lipson Cove Road and 15 CVs turning left out of Lipson Cove Road. Less than one CV is assumed to turn left into Lipson Cove Road from Lincoln Highway north, and the same for the reverse movement (i.e. less than one CV turning right from Lipson Cove Road).

During a peak receivals day (30,000 tonne peak receivals day assumed, in-line with the historical SA export port peak receivals day for a similar facility), approximately 430 freight vehicle receivals per day is assumed to be attracted to the site (resulting in an increase of 980 total two-way movements at the Lincoln Highway / Lipson Cove Road intersection, or 860 two-way CV movements), During a peak hour, 25 freight vehicles receivals are expected (or 50 two-way CV movements) if a 17 hour day is assumed, split such that less than one CV would turn left from Lincoln Highway north into Lipson Cove Road and less than one CV would turn right from Lipson Cove Road, and approximately 24 CVs would turn right into Lipson Cove Road from Lincoln Highway south and 24 CVs turn left from Lipson Cove Road.

This equates to one freight vehicle either entering or exiting the site every 2 minutes on the peak receivals day.

Port Spencer is expected to remove a proportion of the forecast traffic congestion from Port Lincoln (in conjunction with Lucky Bay) by offering an alternate grain receivals site and an alternate export port for the Eyre Peninsula, which would disperse the traffic impact on the existing road freight network (i.e. reduce the freight volumes to Port Lincoln) by adding competition to an otherwise monopolistic market and offer a more cost effective viable alternative for many farmers (i.e. by reducing the vehicle kilometres travelled).

In all trip redistribution scenarios considered with Port Spencer as part of this assessment, the concentrated impact to Lincoln Highway on approach to the site is considered with the road's capacity (i.e. 1800 pc/h per lane). The assumed two-way volume on Lincoln Highway at Lipson Cove Road is up to 185 vehicles per hour during a peak receivals day. Although the turn volumes noted above do not warrant turn treatments based on intersection capacity, channelised treatments are recommended to enhance road safety at the intersection, given the large proportion of turning heavy vehicles during the harvest period.

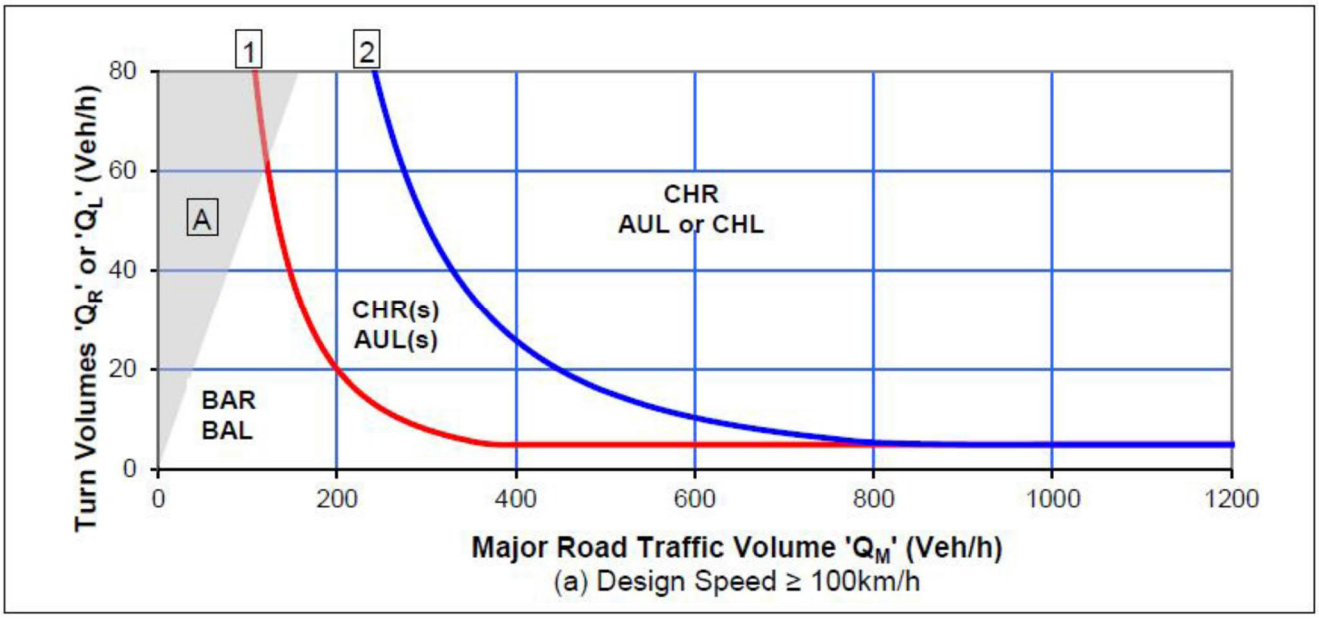


Figure 30: Warrants for turn treatments on major roads at unsignalised intersections (Austroads – Guide to Traffic Management – Part 6, 2017).

Noting Council's concerns for the suitability of Bratten Way between Cummins and Tumby Bay to handle the increase in number of freight vehicles forecast to travel along Bratten Way, alternate east-west links between Tod Highway and Lincoln Highway were considered as part of the Scenario 3 sensitivity testing, which could significantly reduce the freight traffic impact along Bratten Way between Cummins and Tumby Bay.

Feedback received from Councils as part of the Technical Working Group engagement by Peninsula Ports for the Port Spencer development has indicated a likely preference for a new sealed east-west link along the Dog Fence Road route. In its current state, this (Dog Fence Road route) and the other identified east-west unsealed Council road links may not be suited for the potential east-west freight volume increases that may result from this development and other grain port developments in the area if these freight volume increases were to be concentrated along these routes.

Due to these unknowns for future driver behaviour, it is recommended that these unsealed Council roads be monitored for future east-west freight volume increases to inform any new future strategic east-west freight link upgrades.

Outside harvest season, the freight impact is expected to be significantly reduced as the site is not expected to receive any grain receivals for storage onsite outside harvest, but may accept grain from external storages for direct loading onto vessels as required to meet shipping exports.

Construction Impact

The transport impact during construction is expected to peak during Month 2 (which will see a combination of traffic movements as a result of construction activities including the delivery of construction materials and equipment), or Months 10 – 11 (which will see a combination of traffic movements predominately associated with the construction labour force).

From a traffic capacity viewpoint, the peak construction traffic impact of the proposal is considered to be minimal. With total two-way daily traffic volumes of up to 204 trips per day on Lipson Cove Road and up to 1,088 trips per day on Lincoln Highway (between Wharminda Road and Ungarra Road) during construction, the adjoining access roads will continue to operate at Level of Service (LOS) "A" (i.e. uncongested) with construction traffic. The OD vehicles will operate under pilot and may be pulled over when necessary to minimise traffic delay.

To ensure transportation impacts are minimal on the road network, a separate Traffic Management Plan (TMP) should be developed for the construction and operation of the site, once more details are known about the construction and operational phases.

6.3 Road Network Improvements

It is recommended that the following road network improvements be made to improve safety on the surrounding road network during site operations, noting the large number of heavy vehicles attracted to Port Spencer:

- New Intersections:
  - **Entry Access Point (T1):** Basic left turn treatment from major road (Lipson Cove Road).
  - **Exit Access Point (T2):** Basic right turn treatment from minor road (site access road).

Figure 31: Example of a basic left turn (BAL) treatment from major road (Source: Austroads)

Figure 32: Example of a basic left turn (BAL) treatment from minor road (Source: Austroads)

- Intersection Upgrades:
  - **Lipson Cove Road / Lincoln Highway intersection:** Full channelised turn treatment. Channelised right turn treatment from major road (Lincoln Highway) to be provided to allow for two queued Road Trains. Channelised left turn treatment from major road (Lincoln Highway) to be provided. Channelised left turn treatment from minor road (Lipson Cove Road) to merge into a add lane on Lincoln Highway exit to allow for slow moving vehicles to come up to speed.

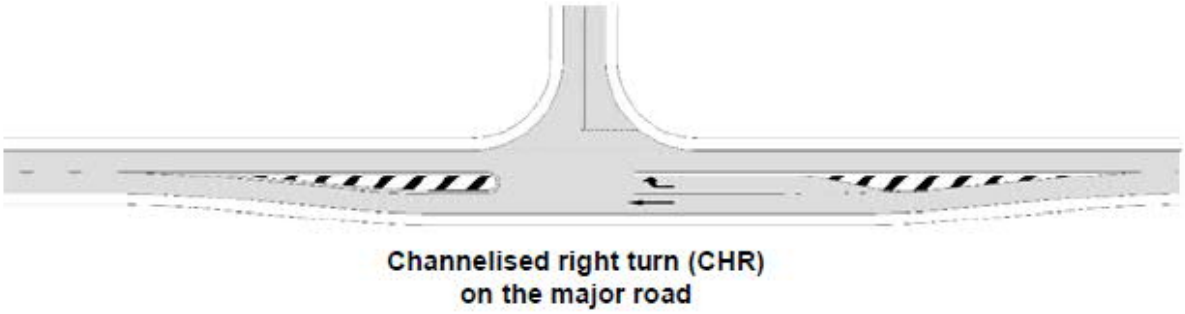


Figure 33: Example of a channelised right turn (CHR) treatment from major road (Source: Austroads)

Figure 34: Example of a channelised left turn (CHL) treatment from major road (Source: Austroads)

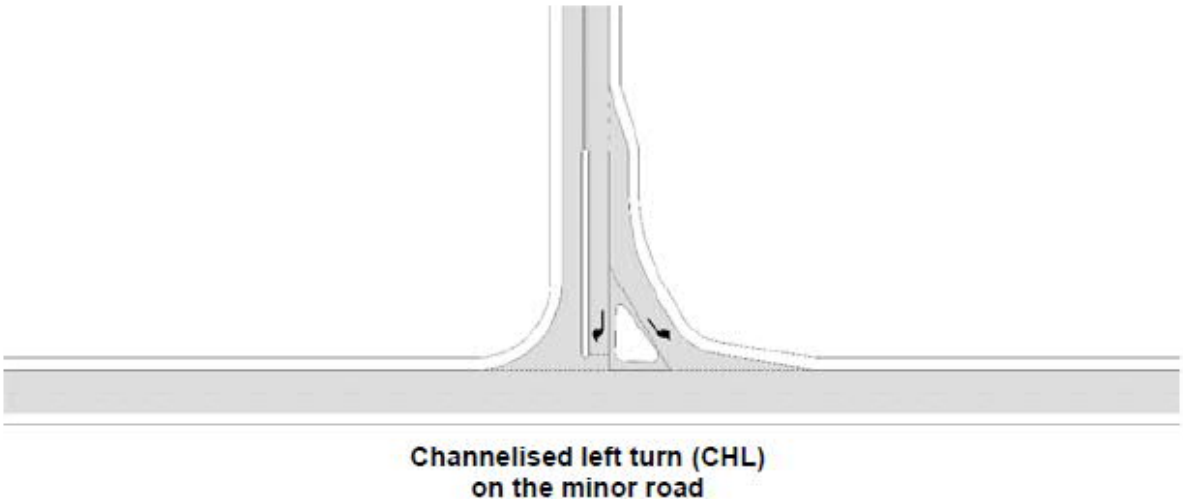


Figure 35: Example of a channelised left turn (CHL) treatment from minor road (Source: Austroads)

- Road Upgrades:
  - **Lipson Cove Road:** Between Lincoln Highway and 50 m beyond Exit Access Point (T2), provide full sealed pavement (noting increased heavy vehicle loading) (also benefit in dust suppression) and localised vegetation trimming (to improve sight lines). Maintain existing priority controls for junction with South Coast Road (located along road section).

Further discussion with the Department of Planning, Transport and Infrastructure and Council would be required to reach agreement on the detailed design of the recommended road network improvements.

Road network improvements beyond those recommended above may be required, but cannot be solely attributed to this proposed development due to the numerous other recent changes across the wider Eyre Peninsula region.

7. Conclusions

It is recognised that the traffic and transport issues arising from the proposed Port Spencer development will impact the wider Eyre Peninsula road network. However, it should be noted that numerous other changes across the wider Eyre Peninsula region have also recently occurred which contribute to the road network impact (when compared to the current existing situation):

- Prior to 31 May 2019, the Eyre Peninsula rail network was operated by Genesee & Wyoming Australia (GWA) under licence from the South Australian Government to transport grain to Viterra's Port Lincoln terminal. Now, the railway line is not operational.
- Viterra plans to close six silo sites on the Eyre Peninsula (that being Minnipa, Kyancutta, Cungena, Waddikee, Kielpa and Wharminda) prior to the 2019/20 harvest season.
- It is also noted that a new T-Ports grain export port at Lucky Bay is expected to be fully operational for the 2019/2020 harvest.

The impact of these changes to the existing traffic conditions on the wider Eyre Peninsula road network is not yet fully understood, noting that a seasonal peak grain harvest period (which sees an increase of freight activity throughout the region) has not yet occurred since these changes. These changes are thought to have a significant impact on the existing road freight network.

This assessment has made several assumptions of the impact resulting from these recent changes, to better understand the new baseline transport situation and the impact in conjunction with the proposed Port Spencer.

The impact that could be directly attributed to the Port Spencer development will primarily occur during the seasonal grain harvest period, when the site is expected to receive up to 1 million tonnes of grain per annum (assumed to be within an eight week period between October and December).

Although the estimated increase in freight volumes converging to Lincoln Highway and Lipson Cove Road of up to 980 total two-way movements at the Lincoln Highway / Lipson Cove Road intersection (or up to 860 two-way CV movements) per day during the seasonal peak harvest period, the roads will still operate under capacity. Upgrades to the road network are proposed to improve safety on the surrounding road network during site operations, noting the large number of heavy vehicles attracted to Port Spencer.

In comparison, the peak construction traffic impact of the proposal is considered to be minimal.

Based on this assessment undertaken for the proposed Port Spencer development, the following conclusions can be made:

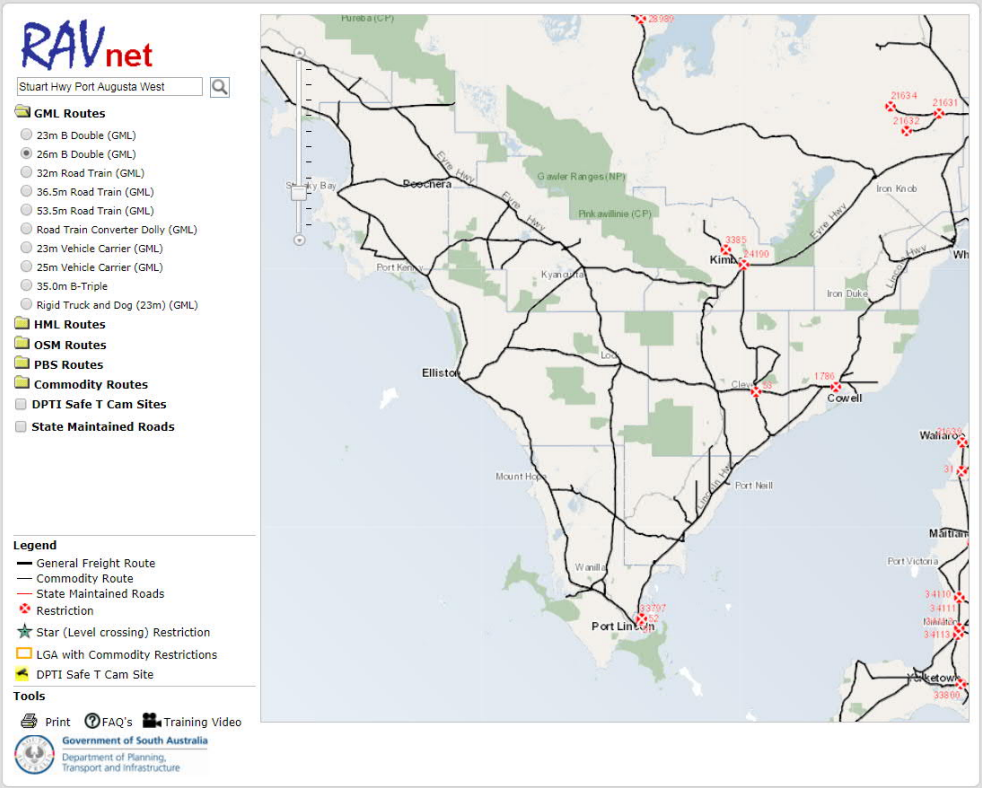
- Two new site accesses will require new basic intersections treatments from Lipson Cove Road, noting the low traffic volume continuing past the site to the Lipson Cove camp grounds.
- Lipson Cove Road is the proposed heavy vehicle route for grain commodity vehicles from Lincoln Highway, as it provides the most direct route from the Lincoln Highway and connectivity into the wider freight restricted access vehicle road network.
- Due to the large number of heavy vehicles trips generated to the site during the seasonal harvest period operations, it is recommended that:
    - Lipson Cove Road be upgraded to a sealed road to aid dust suppression and provide strengthened road pavement, and localised vegetation trimming undertaken to improve sight lines.
    - Lipson Cove Road / Lincoln Highway intersection be upgraded to provide for full channelised turn movements, to improve the efficiency and safety of traffic movement at the intersection given the large number of turning vehicles which intersection is expected to experience.

  - Road network improvements beyond this area may be required, but cannot be solely attributed to this proposed development due to the numerous other recent changes across the wider Eyre Peninsula region as documented above.

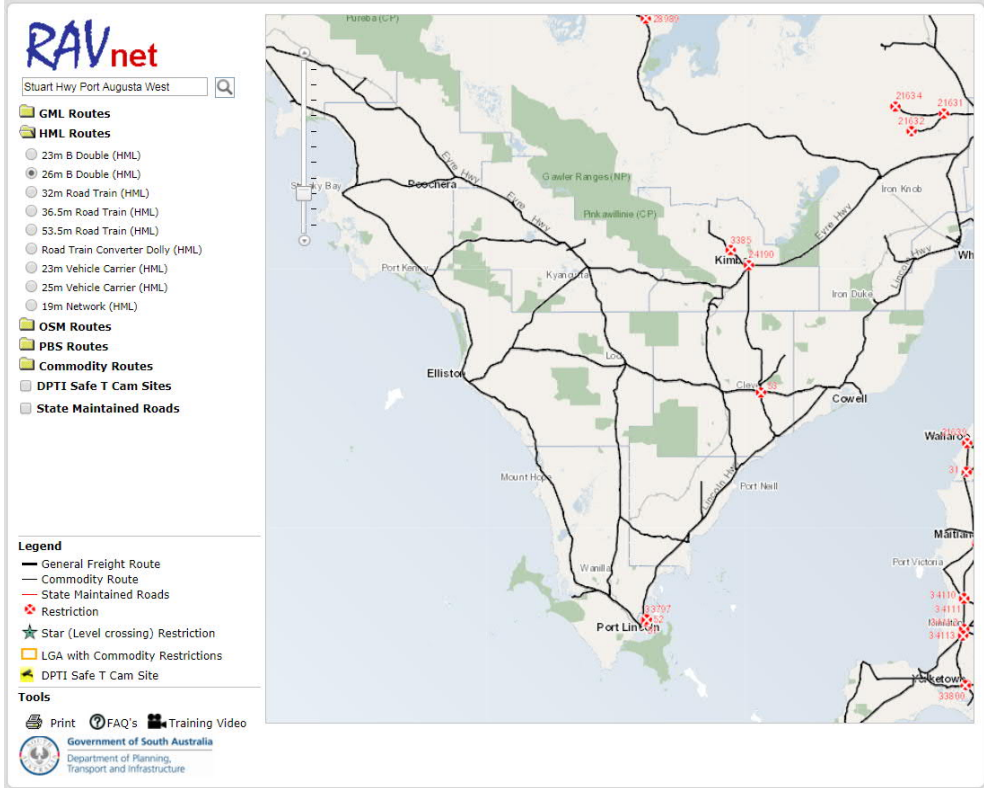
- Due to the greatly reduced traffic generation during the construction phase of the project, no significant construction traffic impacts have been identified beyond the operational stage impacts.
- Permits will need to be obtained from NHVR and DPTI for all vehicles transporting equipment and materials to Port Spencer during construction which are outside the mass and dimension limits of current gazetted highways and roads.
- A detailed Traffic Management Plan (TMP) will need to be prepared in consultation with DPTI and Council prior to construction and operations to manage the overall traffic and transport impact to the State and Council owned and operated roads.
- Noting Council's concerns for the suitability of Bratten Way between Cummins and Tumby Bay to handle the increase in number of freight vehicles forecast to travel along Bratten Way, and their likely preference for a new sealed east-west link along the Dog Fence Road route, it is recognised that:
  - In its current state, this (Dog Fence Road route) and the other identified east-west unsealed Council road links may not be suited for the potential east-west freight volume increases that may result from this development and other grain port developments in the area, if these east-west freight volume increases were to be concentrated along these routes.
  - Due to the unknowns surrounding future driver behaviour and changes in the east-west grain commodity route transport preferences, it is recommended that the unsealed Council roads between Tod Highway and Lincoln Highway be monitored for future east-west freight volume increases during the seasonal harvest period to inform any new future strategic east-west freight link upgrades, as recommended in the Eyre Peninsula *2019 Regional Transport Strategy* (SMEC, 2019).

Appendix A. Restricted Access Vehicle Network Maps

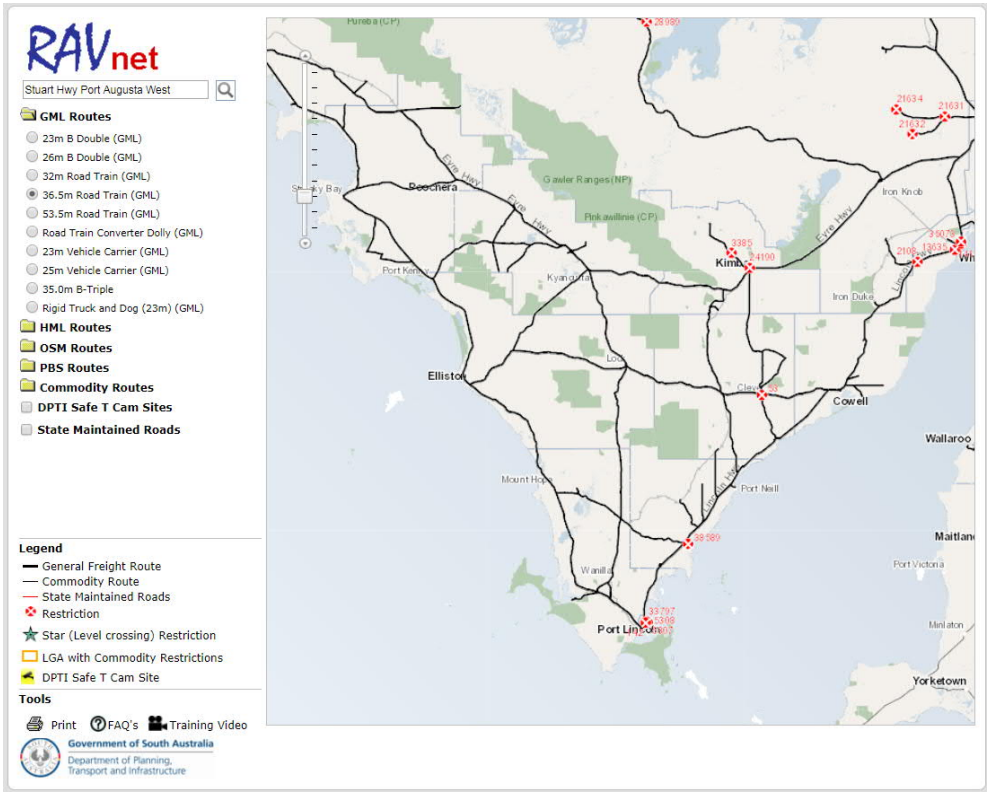
GML Route – 26 m B-double



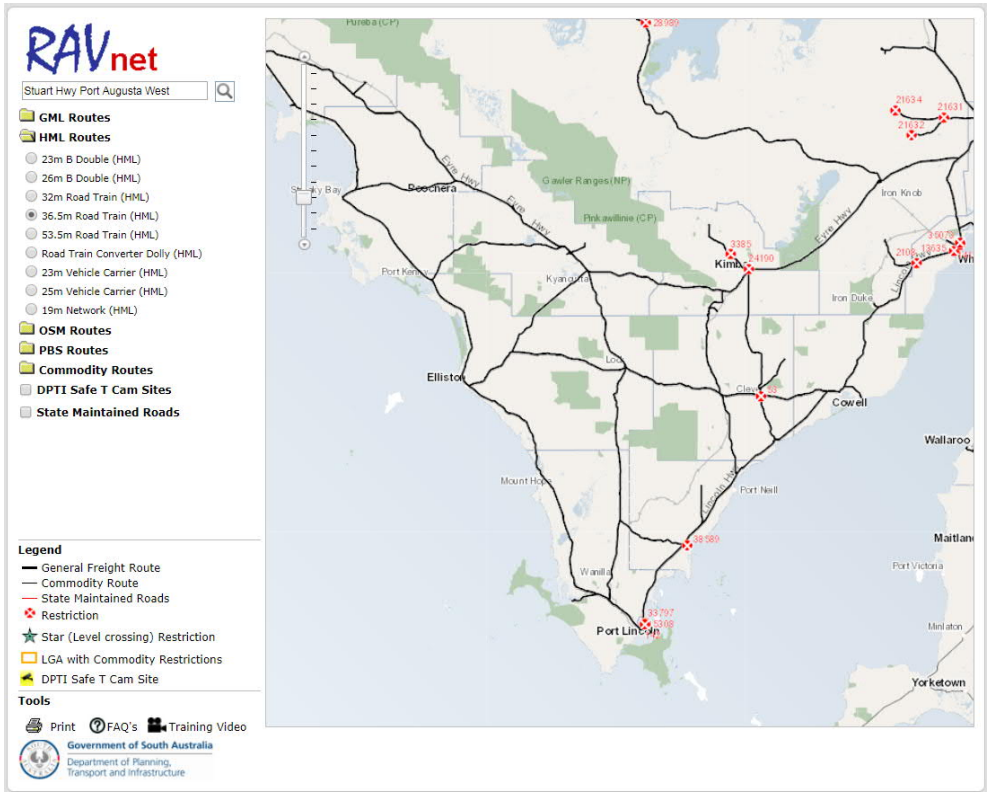
HML Route – 26 m B-double



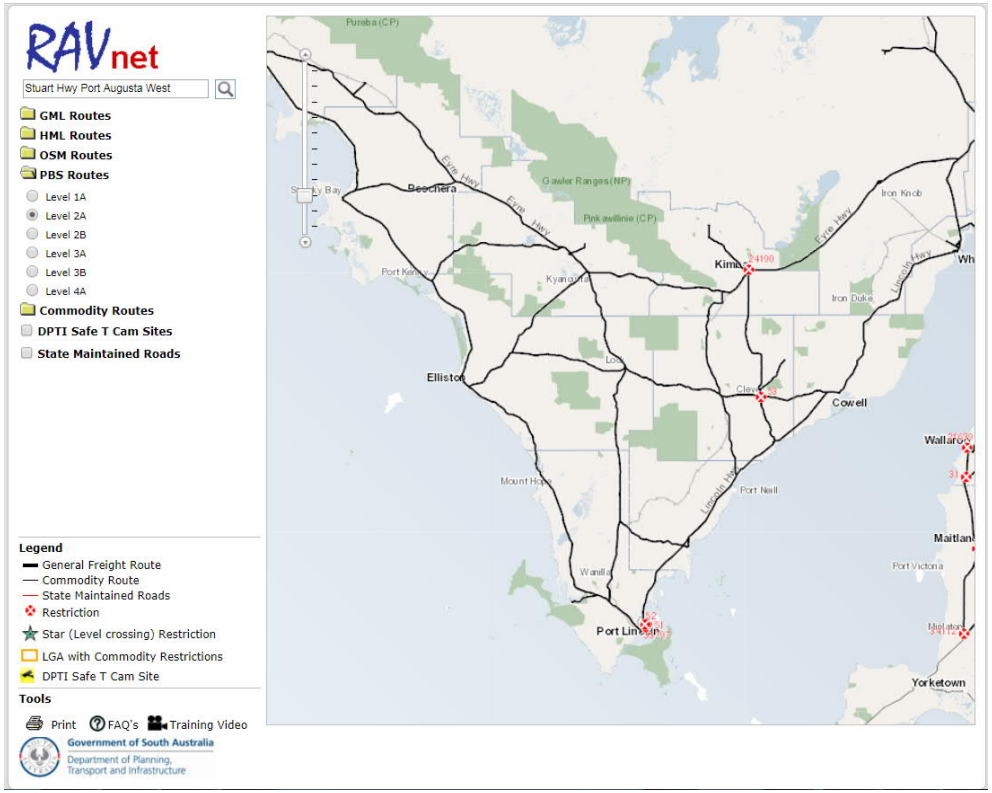
GML Route – 36.5 m Road Train



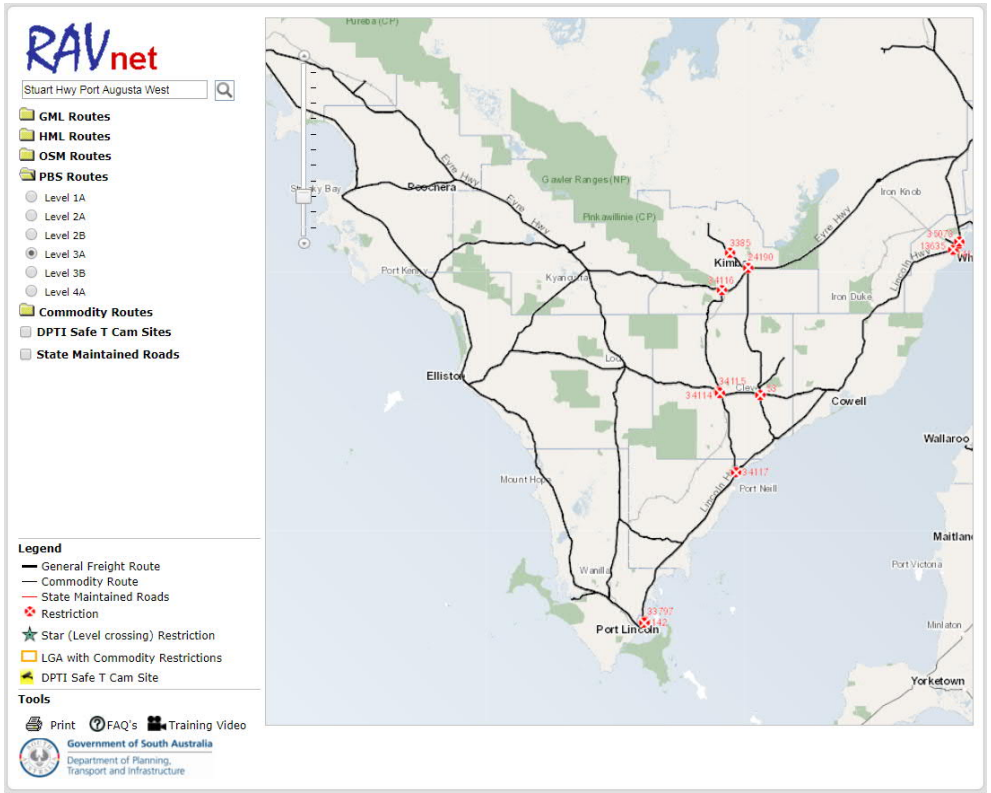
HML Route – 36.5 m Road Train



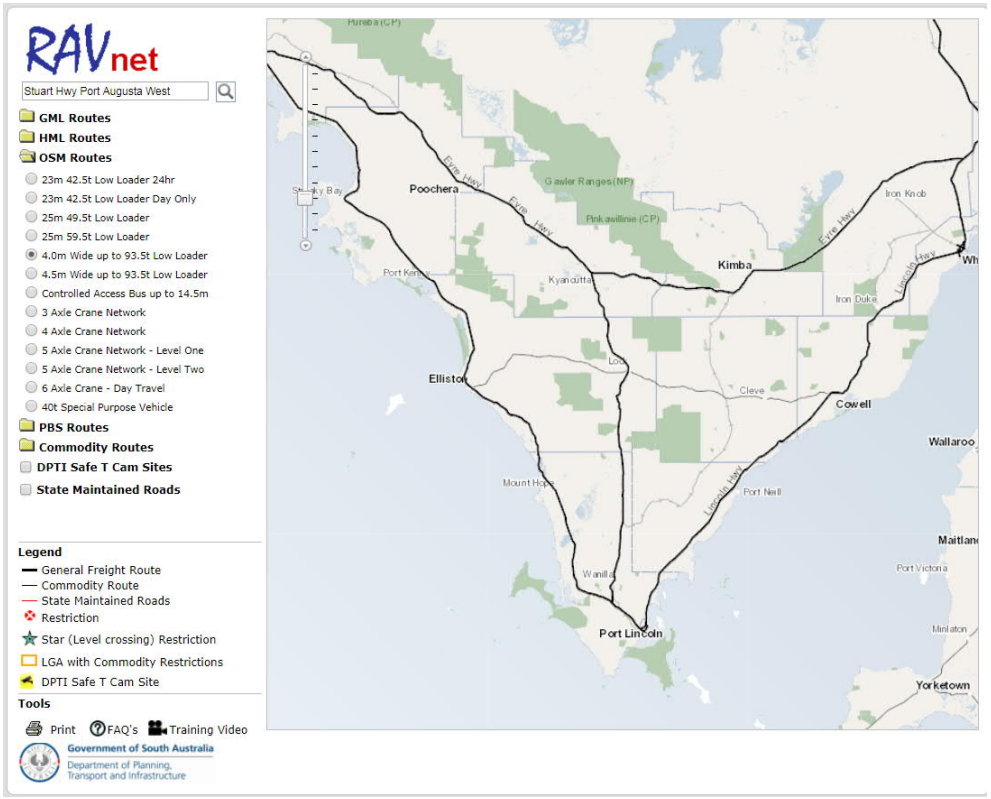
PBS Route – Level 2A



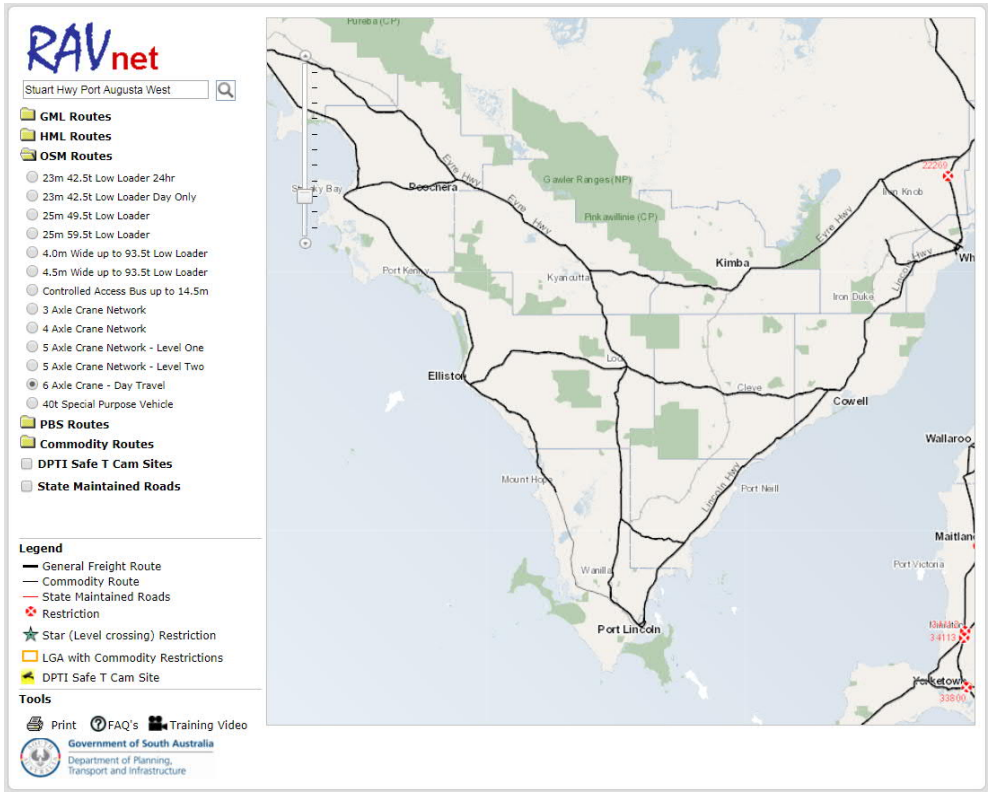
PBS Route – Level 3A



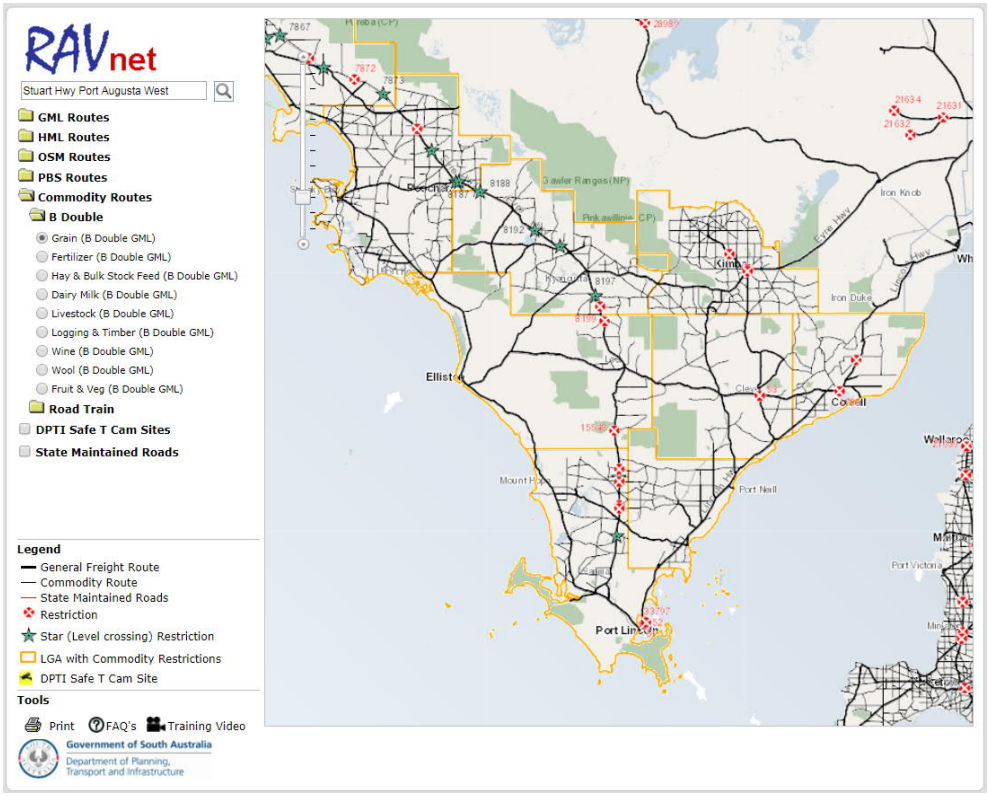
OSM Route – 4.0 m wide up to 93.5t low loader



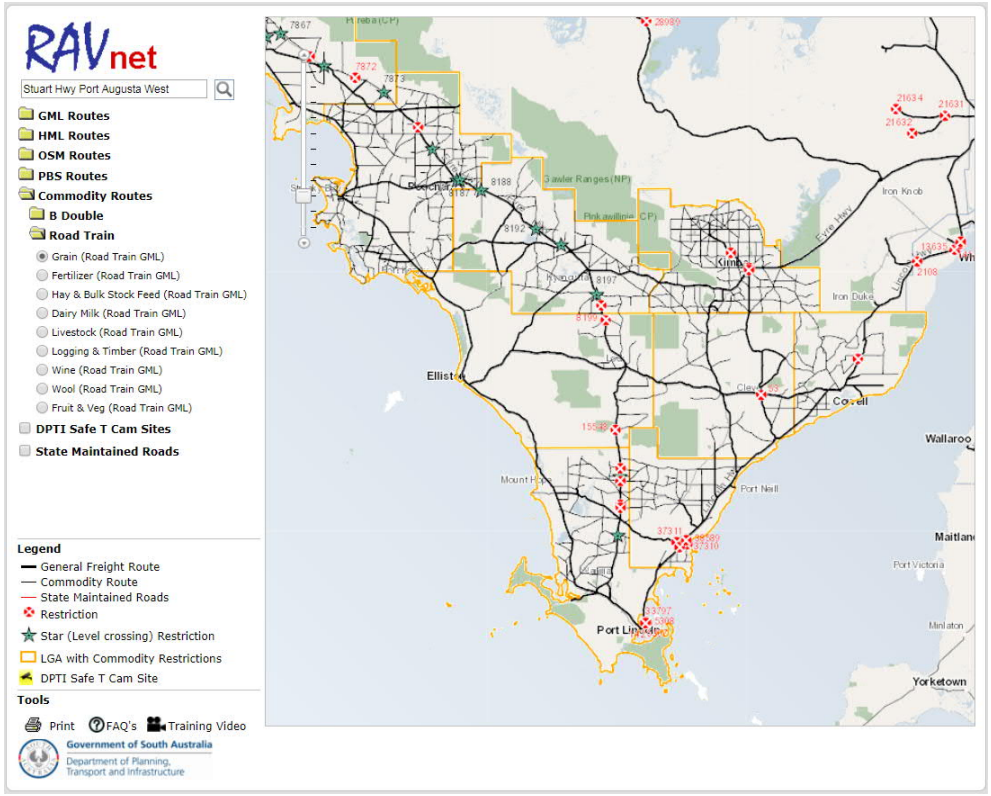
OSM Route – 6 Axle Crane



Commodity Route – Grain (B Double)



Commodity Route – Grain (Road Train)



Local Government Restrictions – for Grain Commodity Routes

THE DC OF CLEVE (572)

1. All council gazetted roads have a 70 kph speed restriction

THE DC OF ELLISTON (573)

1. Speed limits to be a maximum of 60kph on all commodity routes
2. Hauling vehicles to be fitted with yellow revolving flashing lights that can be seen through 360 degrees by oncoming or approaching traffic
3. Driver to stop and give way to other road users where they would normally have priority to allow the other vehicle to clear the intersection prior to the Restricted Access Vehicle undertaking a turning manoeuvre
4. No access to Commodity Routes where there has been greater than 30mm of rain in any 24 hour period

THE DC OF FRANKLIN HARBOUR (574)

1. Restricted speed loaded or unloaded to 80kph on sealed Council roads outside town limits.
2. Restricted speed loaded or unloaded to 70kph on unsealed Council roads outside town limits.
3. Restricted speed loaded or unloaded to 40kph within town limits.
4. RAV operators are required to inspect all unsealed routes which have received greater than 15mm of rain in the preceding 24 hours to ensure that the pavement will not be damaged by the RAV operation

THE DC OF KIMBA (575)

1. Restricted speed loaded or unloaded to 80kph on sealed council roads outside town limits
2. Restricted speed loaded or unloaded to 70kph on unsealed council roads outside town limits
3. Restricted speed loaded or unloaded to 40kph within town limits
4. Council has the right to close any district roads if they are deemed to be unsafe or incurring unreasonable damage

THE DC OF LOWER EYRE PENINSULA (577)

1. Restricted speed to 80kph on sealed Council roads outside town limits.
2. Restricted speed loaded or unloaded to 70kph on unsealed Council roads outside town limits.
3. Restricted speed loaded or unloaded to 40kph within town limits.
4. No access to unsealed routes which have received greater than 15mm of rain in the preceding 24 hours.

THE DC STREAKY BAY (552)

1. Restricted speed to 80kph on sealed Council roads outside town limits.
2. Restricted speed loaded or unloaded to 70kph on unsealed Council roads outside town limits. 3. Restricted speed loaded or unloaded to 40kph within town limits.
4. No access to unsealed routes which have received greater than 15mm of rain in the preceding 24 hours

THE DC OF TUMBY BAY (578)

1. Restricted speed loaded or unloaded to 80kph on all sealed council roads outside town limits
2. Restricted speed loaded or unloaded to 70kph on all unsealed council roads outside town limits
3. Restricted speed loaded or unloaded to 40kph within town limits
4. Restricted Access Vehicle operators are required to inspect all unsealed routes which have received greater than 15mm of rain in the preceding 24 hours to ensure that the pavement will not be damaged by the RAV operation.

WUDINNA DISTRICT COUNCIL (576)

1. Restricted speed loaded or unloaded to 70kph on all unsealed council roads outside town limits
2. Restricted speed loaded or unloaded to 80kph on all sealed council roads outside town limits
3. Restricted speed loaded or unloaded to 40kph within town limits
4. Restricted Access Vehicle operators are required to inspect all unsealed routes which have received greater than 15mm of rain in the preceding 24 hours to ensure that the pavement will not be damaged by the RAV operation.
5. Operators may be liable for the cost of pavement repairs.

For other route restrictions, please refer to RAVnet website

Appendix B. Construction Workforce Vehicle Movements

**Based on information provided by ECI Contractors and Peninsula Ports*

Summary Vehicles (two-way movements)																
		1	2	3	4	5	6	7	8	9	10	11	12	13		
Date		1/07/2020	1/08/2020	1/09/2020	1/10/2020	1/11/2020	1/12/2020	1/01/2021	1/02/2021	4/03/2021	4/04/2021	5/05/2021	5/06/2021	6/07/2021		
Days		31	31	30	31	30	31	31	28	31	30	31	30	31		
weeks		4.43	4.43	4.29	4.43	4.29	4.43	4.43	4.00	4.43	4.29	4.43	4.29	4.43		
MacDowell Staff and Contractor Assumptions																
Staff numbers (per day)		20	21	28	26	26	26	25	25	26	24	24	12	5		
Labour force numbers (per day)		18	18	36	54	55	55	55	55	43	58	58	18	0		
Total numbers on site (per day)		38	39	64	80	81	81	80	80	69	82	82	30	5		
Total people movements (per day)		76	78	128	160	162	162	160	160	138	164	164	60	10		
Total people movements (per month)		2,188	2,245	3,566	4,606	4,513	4,663	4,606	4,160	3,972	4,569	4,721	1,671	288		
Cumulitive people movements (per month)		2,188	4,433	7,999	12,604	17,117	21,781	26,386	30,546	34,519	39,087	43,808	45,480	45,767		
12 seater buses required (per day) (to transport all people on site)	12	3.17	3.25	5.33	6.67	6.75	6.75	6.67	6.67	5.75	6.83	6.83	2.50	0.42		
52 seater buses required (per day) (to transport all people on site)	52	0.73	0.75	1.23	1.54	1.56	1.56	1.54	1.54	1.33	1.58	1.58	0.58	0.10		
Bussing Assumptions (per day)	24	1	1	2	2	2	2	2	2	2	1	1	0	0		
	52			0	0	0	0	0	0							
	12			1	2	2	2	2	2	1	1	1	1	0		
Total bus seats (per day)	24	24	24	48	48	48	48	48	48	48	24	24	0	0		
	52	0	0	0	0	0	0	0	0	0	0	0	0	0		
	12	0	0	12	24	24	24	24	24	12	12	12	12	0		
Total bus seats (per month)		1,382	1,382	3,343	4,145	4,011	4,145	4,145	3,744	3,454	2,006	2,073	669	0		
Light vehicle moves (per month) (assuming no sharing)		806	864	223	461	501	518	461	416	518	2,563	2,648	1,003	288		
SUB TOTAL																
24 seater bus moves (per month)		58	58	111	115	111	115	115	104	115	56	58	0	0	1,016	HEAVY VEHICLES
12 seater bus moves (per month)		0	0	56	115	111	115	115	104	58	56	58	56	0	844	LIGHT VEHICLES
Light vehicle moves (per month)		806	864	223	461	501	518	461	416	518	2563	2648	1003	288	11,270	LIGHT VEHICLES
Light truck vehicle moves (per month)		58	58	56	58	56	58	58	52	58	56	58	56	58	736	LIGHT VEHICLES
Other Staff and Contractor Assumptions																
Staff & labour force numbers (per day)		35	35	70	70	70	70	70	70	70	70	70	35	0		
Total numbers on site (per day)		35	35	70	70	70	70	70	70	70	70	70	35	0		
Total people movements (per day)		70	70	140	140	140	140	140	140	140	140	140	70	0		
Total people movements (per month)		2,015	2,015	3,900	4,030	3,900	4,030	4,030	3,640	4,030	3,900	4,030	1,950	0		
Cumulitive people movements (per month)		2,015	4,030	7,930	11,960	15,860	19,890	23,920	27,560	31,590	35,490	39,520	41,470	41,470		
12 seater buses required (per day) (assuming 60% transported by bus)	12	1.75	1.75	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	1.75	0.00		
Bussing Assumptions (per day)	24	1	1	1	1	1	1	1	1	1	1	1	1			
	52															
	12			2	2	2	2	2	2	2	2	2				
Total bus seats (per day)	24	24	24	24	24	24	24	24	24	24	24	24	24	0		
	52	0	0	0	0	0	0	0	0	0	0	0	0	0		
	12	0	0	24	24	24	24	24	24	24	24	24	0	0		
Total bus seats (per month)		1,382	1,382	2,674	2,763	2,674	2,763	2,763	2,496	2,763	2,674	2,763	1,337	0		
Light vehicle moves (per month) (assuming 1.5 people per vehicle)		633	633	1,226	1,267	1,226	1,267	1,267	1,144	1,267	1,226	1,267	613	0		
SUB TOTAL																
24 seater bus moves (per month)		58	58	56	58	56	58	58	52	58	56	58	56	0	678	HEAVY VEHICLES
12 seater bus moves (per month)		0	0	111	115	111	115	115	104	115	111	115	0	0	1,014	LIGHT VEHICLES
Light vehicle moves (per month)		633	633	1226	1267	1226	1267	1267	1144	1267	1226	1267	613	0	13,034	LIGHT VEHICLES
Light truck vehicle moves (per month)		0	0	0	0	0	0	0	0	0	0	0	0	0	-	LIGHT VEHICLES
TOTAL VEHICLE MOVEMENTS PER MONTH																
24 seater bus moves (per month)		115	115	167	173	167	173	173	156	173	111	115	56	0	1,694	HEAVY VEHICLES
12 seater bus moves (per month)		0	0	167	230	223	230	230	208	173	167	173	56	0	1,858	LIGHT VEHICLES
Light vehicle moves (per month)		1439	1497	1449	1727	1727	1785	1727	1560	1785	3789	3915	1616	288	24,303	LIGHT VEHICLES
Light truck vehicle moves (per month)		58	58	56	58	56	58	58	52	58	56	58	56	58	736	LIGHT VEHICLES
Total vehicle moves per month		1,612	1,670	1,839	2,188	2,173	2,245	2,188	1,976	2,188	4,123	4,260	1,783	345		
Cumulative vehicle moves per month		1,612	3,282	5,120	7,308	9,481	11,726	13,914	15,890	18,077	22,200	26,461	28,243	28,589		
TOTAL VEHICLE MOVES PER DAY		53	55	63	72	74	74	72	72	72	139	139	60	12	PEAK DAY	
24 seater bus moves (per day)		4	4	6	6	6	6	6	6	6	4	4	2	0	4	HEAVY VEHICLES
12 seater bus moves (per day)		0	0	6	8	8	8	8	8	6	6	6	2	0		
Light vehicle moves (per day)		47	49	49	56	58	58	56	56	58	127	127	54	10	135	LIGHT VEHICLES
Light truck vehicle moves (per day)		2	2	2	2	2	2	2	2	2	2	2	2	2		

END OF DOCUMENT

Appendix C. Terrestrial Ecology Assessment

Port Spencer Grain Export Terminal

Terrestrial Vegetation Survey

IW219900-0-NP-RPT-0001 | 0

30 September 2019

Peninsula Ports

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
C	18 Sept 2019	Draft for internal review	S Croft	A Horan	N Bull	A Horan
0	30 Sept 2019	For issue	S Croft	A Horan	N Bull	D Mollison

Port Spencer Grain Export Terminal

Project No:	IW219900
Document Title:	Terrestrial Vegetation Survey
Document No.:	IW219900-0-NP-RPT-0001
Revision:	0
Date:	30 September 2019
Client Name:	Peninsula Ports
Project Manager:	Scott Snedden
Author:	Sonia Croft
File Name:	Appendix C_Terrestrial Vegetation Survey August 2019_Rev 0

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Contents

Executive Summary

Peninsula Ports is seeking to amend an existing Development Plan consent under Section 47 of the *Development Act 1993.* The Development Plan consent was originally granted to Centrex Metals for a deep-sea port facility at Port Spencer to export both iron ore and grain from the site and was transferred to Peninsula Ports in mid-2019 following purchase of the land from Centrex Metals.

This terrestrial vegetation survey, comprising desktop review and site survey, has been undertaken to enable a revised estimated Significant Environmental Benefit (SEB) to be calculated for the Proposed Amendment based on the revised project layout and the changes to the calculation of the SEB which were introduced by the *Native Vegetation Regulations 2017.*

Listed Plant Species

A search of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters database (with a 5 km buffer) identified six listed plant species as potentially present within the project area. None of the species identified as potentially present are considered likely to occur at the site.

Listed Fauna Species

A search of the *EPBC Act* Protected Matters database identified nine listed fauna species recorded within a 5 km buffer of the project area. Based on the mapped vegetation associations in this report, it is considered potentially suitable habitat is present at the project site for only the Rock Parrot (the coastal dunes and slopes may provide non-breeding habitat).

Threatened Ecological Communities

No threatened ecology communities are present in the project area.

Weeds

Two Weeds of National Significance were identified within the project site boundary:

- *Lycium ferocissimum* (African Boxthorn) was widespread within all habitats within the project site, except for the coastal dunes. African Boxthorn is also a Declared Plant under the *Natural Resources Management Act 2004.*
- *Lycium ferocissimum* was sparsely present within rocky outcrop areas.

In addition to African Boxthorn, the Declared plant *Pinus halapensis* (Aleppo pine) was recorded on Swaffers Road. *Asphodelus fistulosus* (Onion Weed) was widespread and common, to locally dominant in the survey area. However, this species is not currently a Declared Plant.

Vegetation Associations present at the Project Site

Distinct vegetation assemblages were surveyed within the project site boundary, using the Bushland Assessment Method (BAM) (NVC 2017). Native vegetation within the project boundary occurs in the following habitats:

- Rocky Slopes adjoining the coast (BAM sites 1 and 1a (*Lomandra effusa* sedgeland) and BAM 4 (*Triodia* closed hummock grassland)
- Coastal dunes with *Olearia axillaris* +/- *Westringia dampieri* (BAM sites 2 and 2b),
- Saline clay flat supporting a *Nitraria billardierei* tall shrubland (BAM site 3), and
- Unploughed rocky outcrops within the fallow paddock (BAM site 5 and BAM 6).

The vegetation associations and area (ha) occupied within the project site are summarised in Table E-1. Areas of the site outside of these BAM sites did not contain native vegetation.

Table E-1 BAM site vegetation associations and area (ha) occupied within the project site.

BAM Site	Association/habitat	Area (ha)
1	*Lomandra effusa* (Scented Mat-rush) sedgeland on rocky slopes above coast	1.5
1a	*Lomandra effusa* (Scented Mat-rush) very open sedgeland on rocky slopes above coast	0.69
2	*Olearia axillaris* (Coast Daisy-bush) very open shrubland on coastal hind dunes	4.3
2b	*Olearia axillaris* (Coast Daisy-bush) – *Westringia dampieri* (Shore Westringia) open shrubland on coastal fore dunes	1.2
3	*Nitraria billardierei* (Nitre-bush) Tall Open Shrubland	5.6
4	*Triodia scariosa* (Spinifex) closed hummock grassland	0.63
5	*Asphodeuls fistulosus* (Onion Weed) open herbland	5.9
6	*Lomandra effusa* (Scented Mat-rush) +/- *Gahnia lanigera* (Black Grass Saw-sedge) +/- *Lepidosperma* sp. (Rapier Sedge) sedgeland on rocky outcrops in fallow paddock	1.2

Comparison with Terrestrial Vegetation Recorded for the Evaluated Project

The outcomes of the terrestrial vegetation survey undertaken in 2019 were compared with the baseline terrestrial vegetation survey completed by Golder Associates (2009) in November 2008. In general, there has been little apparent change in native species composition and abundance since 2008, except for the rocky slopes adjoining the coast. However, the differences are difficult to assess due to different seasonal timing of surveys and different sized survey sites.

There has been an increase in the reporting of weeds in the rocky slopes and saline shrublands in 2019. It is considered there has been an actual increase in high risk weeds African Boxthorn and Marguerite daisy. However, the increased reporting of weeds other than African Boxthorn in 2019 in the saline shrubland may reflect season of survey (most species were annuals).

<u>Rocky Slopes adjoining the coast</u>

In 2008, *Enchylaena tomentosa* (Ruby Saltbush) was estimated to cover > 25% of the survey site, compared with < 5% cover in 2019. Conversely, the 2019 survey recorded a higher cover of *Triodia scariosa* (Spinifex Grass) (up to 75%) compared with 26 – 50% cover in 2008. The highly invasive Marguerite daisy was recorded from this habitat only in 2019. The abundance of Boxthorn also appears to have increased from 2008 to 2019.

The higher number of native species recorded in 2019 (35 compared with 18 on 2008) is likely a combination of more annual species being evident due to the time of year surveyed, and a greater area surveyed (the two BAM sites were one hectare each, compared with 0.09 ha for the one Biological Survey of SA site).

<u>Coastal dunes with *Olearia axillaris* +/- *Westringia dampieri*</u>

Minimal changes were observed in the coastal dunes habitat between 2008 and 2019. The greatest apparent change is the estimated decline in Marguerite Daisy from 6 – 25% cover in 2008, to < 1% cover in 2019.

Saline clay flat supporting a *Nitraria billardierei* tall shrubland

There appears to have been little apparent change between 2008 and 2019. There has possibly been a decline in Samphire (*Tecticornia pergranulata*), and an increase in exotic species. The only weed species recorded in 2008 was Iceplant (*Mesembryanthemum crystallinum*). However, 10 weed species were recorded in 2019, including African Boxthorn. Most weed species present in 2019 were annuals, or seasonally evident, which may explain the relative absence of weeds in 2008.

Unploughed rocky outcrops within the fallow paddock

There appears to have been no significant changes in native vegetation cover on the rocky outcrop areas in the fallow paddocks.

Lipson Cove Road Vegetation Associations

Native plants were absent or not obvious for most of the northern side of the Lipson Cove Road reserve. Two distinct vegetation associations were recognised on the southern side of Lipson Cove Road Reserve:

- *Acacia pycnantha* (Golden Wattle) – *Allocasuarina verticillata* (Drooping Sheoak) – *Eucalyptus angulosa* (Coast Ridge-fruited Mallee) Low Open Woodland occurred along the eastern half of Lipson Cove Road.
- Senna very open shrubland with emergent *Eucalyptus gracilis, E. dumosa, E. peninsular*s) occurred along the western half of Lipson Cove Road. Native shrubs and trees occurred discontinuously, often with large gaps comprised of exotic weeds and grass.

Terrestrial vegetation along Lipson Cove Road was not assessed as part of the Evaluated Project.

Swaffers Road

Jacobs has compared the 2008 qualitative survey description to vegetation dominants and condition in 2019. There appears to have been no significant change between 2008 and 2019 in six of the nine road segments. Slight increases in native species were reported for three segments in 2019 (SW3, SW5 and SW6).

Swaffers Road is currently not proposed to be used as part of the Proposed Amendment.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs was to provide details regarding vegetation present and clearance required for the proposed grain export terminal at Port Spencer, South Australia, in accordance with the scope of services set out in the contract between Jacobs and the client, Free Eyre Limited (FEL). That scope of services, as described in this report, was developed by Jacobs.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and / or from other sources (e.g. DEW). Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of the client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

Port Spencer (the site) was originally proposed by Centrex Metals Limited in 2011 as a deep-sea port facility for the export of iron ore from their Eyre Iron Joint Venture Project. At this time, Free Eyre Limited (FEL) was the preferred grain supplier and was closely involved in the planning for the project. The project was declared a Major Development under the *Development Act 1993* and it was determined that the project would be subject to a Public Environment Report (PER) process. The Port Spencer site was owned by Centrex Metals and the Port Spencer Stage 1 Project (the Evaluated Project) successfully received Provisional Development Plan consent to export both iron ore and grain from the site.

The provisional development authorisation granted to Centrex Metals in 2012 and extended in 2014 currently remains active and was transferred to Peninsula Ports (a subsidiary of FEL) in mid-2019 following purchase of the land from Centrex Metals. Given Peninsula Ports only intends to export grain from the Port Spencer site, Peninsula Ports is seeking to amend the existing Development Plan consent under Section 47 of the *Development Act 1993.* The amendment process is required to take account of alterations to the Evaluated Project and to update the PER due to the length of time that has passed since the PER was prepared.

This terrestrial vegetation survey has been undertaken to enable a revised estimated Significant Environmental Benefit (SEB) to be calculated for the Proposed Amendment based on the revised project layout and the changes to the calculation of the SEB which were introduced by the *Native Vegetation Regulations 2017.* It also provides a high-level comparison with the terrestrial vegetation values reported in the PER.

This report is a terrestrial assessment only, and the marine environment is addressed elsewhere.

2. Method

Desktop database searches were undertaken to review conservation significant flora and fauna species, as well as threatened ecological communities which may be present at the site. Searches undertaken included:

- The *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters database via the online Protected Matters Search Tool (PMST, search 19 August 2019) with a buffer of 5 km (see Appendix A).
- Department of Environment and Water (DEW) Biological Database of South Australia (BDBSA), with data output with a 5 km buffer.

On 29 August 2019, Jacobs personnel, including Native Vegetation Accredited Consultants, surveyed distinct vegetation assemblages within the project site boundary, using the Bushland Assessment Method (BAM) (NVC 2017). Three of the BAM survey sites were centred on the Biological Survey of South Australia sites undertaken by Golder Associates (2009) in November 2008. The cover/abundance codes used in the Biological Survey of SA sites were converted to cover/abundance codes used in the BAM method, to enable comparisons of plant species cover and abundance between the two survey periods.

On 29 August 2019, Jacob's personnel also surveyed the vegetation along seven kilometres of Lipson Cove Road, dividing the road into two BAM sites.

In 2008, Golder Associates described the vegetation along Swaffers Road, dividing the entire length of the road into 10 sections. On 29 August 2019, Jacobs did rapid BAMs over three of the more densely vegetated sections. For the remaining seven sections of Swaffers road, field notes were recorded, and results compared to the descriptions provided by Golder (2009). This Proposed Amendment does not propose to use Swaffers Road, and this data was collected for background and comparative purposes only.

BAM data collected during the survey was used to describe vegetation assemblages present on site, and to rate the condition of the remnant vegetation present via the unit biodiversity scores. Data collected will also support a future calculation of SEB offset requirement and an application to clear native vegetation.

3. Results

This section presents the combined results of the desktop review and field survey.

3.1 Listed Plant Species

No plant species listed under the *Environment Protection Biodiversity Conservation (EPBC) Act 1999* or the *National Parks and Wildlife Act 1972* were recorded on site during the field assessment.

3.1.1 EPBC Protection Matter Search Tool (PMST)

The PMST (19 August 2019) listed the following plant species as potentially present at the site or within the applied buffer:

- *Acacia enterocarpa* (Jumping-jack Wattle)
- *Acacia pinguifolia* (Fat-leaved Wattle)
- *Caladenia brumalis* (Winter Spider-orchid)
- *Caladenia tensa* (Rigid Spider-orchid)
- *Prostanthera calycina* – West Coast Mintbush
- *Pultenaea trichophylla* – Tufted Bush-pea.

The likelihood of EPBC listed species occurring within the survey area is assessed in Table 3-1. None of the species identified as potentially present are considered likely to occur at the site.

Table 3-1 EPBC Protected Matters likelihood assessment

Scientific Name	Common Name	EPBC Act Status	Preferred Habitat	Potential to occur on site
Acacia enterocarpa	Jumping-jack Wattle	Endangered	Woodland or open forest growing on a variety of loam and clay soils (Seedbank SA 2019). Up to 20 records within 20 km of site	Unlikely. If present, most likely to occur on Lipson Cove Road. However, this is a distinctive species and unlikely to be overlooked. The species was not recorded during the survey of Lipson Cove or Swaffers Roads
Acacia pinguifolia	Fat-leaved Wattle	Endangered	On Eyre Peninsula there are three main populations: northern Koppio Hils; southern Koppio Hills; and west of Cummins between Coulta and Kappinnie (DEH 2006), and found in Eyre Peninsula Blue Gum *Eucalyptus petiolaris*, Sugar Gum *Eucalpytus cladocalyx* low open forest • Ridge-fruited Mallee *Eucalyptus incrassata*, Broombush *Melaleauca uncinata* open scrub	Unlikely. The project area is east of known records. A survey of Swaffers and Lipson Cove Road failed to record this species. Its occurrence in the project footprint is considered unlikely.
Caladenia brumalis	Winter Spider-orchid	Vulnerable	Very sparsely recorded from a variety of habitats on southern Eyre Peninsula. The	Unlikely. Due to the paucity of records

Scientific Name	Common Name	EPBC Act Status	Preferred Habitat	Potential to occur on site
			nearest record to the project area is approximately 20 km south-west (recorded in 1985). Flowers in late winter and flowers in June to September (Seedbank SA 2019)	on southern Eyre Peninsula and the distance to nearest non-historic record is > 40 km, its occurrence within the project footprint is considered unlikely. It was not recorded in late August, a time when it would most likely be flowering and therefore obvious.
Caladenia tensa	Rigid Spider Orchid	Endangered	A taxonomic revision suggests that this species only occurs in the Murray and South East botanical regions of South Australia (DEW 2019)	No longer considered to occur in the Eyre Peninsula region
Prostanthera calycina	West Coast (or Limestone) Mintbush	Vulnerable	Limestone ridges and in mallee vegetation on sandy-loam soils. Associated overstorey species include: • Ridge-fruited Mallee *Eucalyptus incrassata* • Red Mallee *Eucalyptus oleosa* • Beaked Red Mallee *Eucalyptus socialis*. Commonly associated understorey species are *Melaleuca* species, Native Apricot, Quandong, *Grevillea*, *Hakea* and *Spyridium*.	Unlikely. Nearest record is over 40 km SW of project area. Not recorded during survey and considered unlikely.
Pultenaea trichophylla	Tufted Bush-pea	Endangered	Found only in the southern Eyre Peninsula, on the hills around Koppio and Uranno, growing in hilly open woodland or mallee (often dominated by *Eucalyptus cladocalyx* and/or *Melaleuca uncinata* or *Allocasuarina verticillata*) on sandy to clay loam to loamy gravel over ironstone gravel or stony quartz (Seedbank SA 2019)	Unlikely. The project footprint is east of this species' natural range. Not recorded during the survey.

NB: *Tecticornia flabelliformis* and *Frankenia plicata* did **not** appear in the August 2019 Protected Matters search (but were addressed in Golder Associates 2009). These species were not recorded in the saline shrubland zone of the footprint and are considered unlikely.

3.1.2 Regionally Rated Plant Species

The project area occurs within the Eyre Hills Interim Biogeographic Regionalisation for Australia (IBRA) sub-region. Although not recognised in legislation, plant species within each IBRA sub-region have been assigned a regional conservation rating. Three species recorded in the project footprint or nearby roads have a regional conservation rating.

- *Scleranthus pungens* is considered rare for the Eyre Hillls IBRA sub-region (NatureMaps 2019). Approximately five plants were located in two locations within BAM site 6 (refer Plate 1). The individuals were growing near granite outcrops in a *Lomandra effusa* grassland surrounded by fallow paddock.
- *Eucalyptus petiolaris* (Eyre Peninsula Blue Gum) is considered Near Threatened. This species was recorded on Swaffer Road. However, this location is considered to be outside the natural area of occurrence for Eyre Peninsula Blue Gum, and hence is most likely to have been planted along Swaffers

Road. The natural distribution of Eyre Peninsula Blue Gum is mainly in the Koppio Hills, Cleve Hills and west of the Marble Range where the annual rainfall is high (above 370 mm) relative to some other parts of the Peninsula (DoEE 2013). The ecological community is predominantly restricted to well-drained, moderate to high fertility soils associated with sheltered valleys, lower hill slopes and watercourses.

- *Westringia dampieri* (Shore Westringia) was recorded as a co-dominant species in part of the coastal dune. This is considered to be Near Threatened for the Eyre Peninsula region.

Plate 1: *Scleranthus pungens* was recorded at two locations within BAM 6.

3.2 Listed Fauna Species

No fauna species listed under the *Environment Protection Biodiversity Act 1999* or the *National Parks and Wildlife Act 1972* were recorded on site during the field assessment.

3.2.1 PMST results – refer Golder Associates 2009

3.2.2 Fauna species for which the application area provides potentially suitable habitat

Fauna species recorded within a 5 km buffer of the project area are identified in Table 3-2.

Table 3-2 Fauna species recorded in the project area

Common Name	Scientific Name	EPBC Act	NPW Act
Eastern Osprey	*Pandion haliaetus cristatus*		E
White-bellied Sea Eagle	*Haliaeetus leucogaster*		E
Common Sandpiper	*Actitis hypoleucos*		R
Sooty Oystercatcher	*Haematopus fuliginosus*		R
Rock Parrot	*Neophema petrophila*		R
Pacific Golden Plover	*Pluvialis fulva*		R
Peregrine Falcon	*Falco peregrinus*		R
Hooded Plover	*Thinornis cucullatus cucullatus*	VU	V
Australian Sea Lion	*Neophoca cinerea*	VU	V

Of the threatened species recorded within a 5 km buffer, the mapped vegetation associations in this report are considered to provide potentially suitable habitat for only the Rock Parrot (the coastal dunes and slopes may provide non-breeding habitat).

3.3 Threatened Ecological Communities

3.3.1 Subtropical and Temperate Coastal Saltmarsh

The PMST identified the EPBC listed threatened ecological community (TEC) Subtropical and Temperate Coastal Saltmarsh as likely to occur within the area. However, the Saline Shrubland recorded within the project footprint (*Nitraria billardierei* over sparse *Tecticornia pergranulata*) does not meet the criteria defining this TEC. The TEC is subject to “regular or intermittent tidal influence” (TSSC 2013). However, the saline shrubland within the project footprint occurs behind coastal dunes and is not considered to be subject to tidal influence.

3.3.2 Irongrass Temperate Grassland

Irongrass Temperate Grassland is an EPBC listed TEC. This community is dominated by *Lomandra effusa* or *Lomandra multiflora* ssp. *dura*.

BAM survey sites 1 and 6 were mapped as *Lomandra effusa* sedgelands. However, these areas did not meet the EPBC TEC criteria, having < 15 native species and < 4 perennial grass species. Further, this TEC is not recognised as occurring on Eyre Peninsula, although it is mapped as such in DEW’s mapping layer.

3.4 Weeds of National Significance

Lycium ferocissimum (African Boxthorn) is a Weed of National Significance. *Lycium feroccisum* was widespread within all habitats within the project footprint, except for the coastal dunes. At BAM survey sites 1 (*Lomandra effusa* grassland) and 4 (*Triodia scariosa* grassland), at least 30 plants were recorded (about 50 plants within a

1 – 2 ha area). At least 20 *Lycium ferocissimum* were also recorded within BAM site 3 (*Nitraria billardierei*) shrubland. Elsewhere, *Lycium ferocissimum* was sparsely present within rocky outcrop areas.

3.5 Declared Plants under the Natural Resources Management Act 2004

The following Declared Plants were observed on site during the survey:

- *Lycium ferocissimum* (African Boxthorn) – refer to Section 3.4
- *Pinus halapensis* (Aleppo pine) was recorded on Swaffers Road - refer to Section 3.8.

NB: *Marrubium vulgare* (Horehound), a Declared Plant was recorded in 2008 (Golder Associates 2009) but not during the 2019 survey.

Asphodelus fistulosus (Onion Weed) was widespread and common, to locally dominant. However, this species is not currently a Declared Plant.

3.6 Project Site Native Vegetation Associations

BAM site data is presented in Appendix B. Native vegetation within the project boundary occurs in the following habitats:

- Rocky Slopes adjoining the coast (BAM sites 1 and 1a (*Lomandra effusa* sedgeland) and BAM 4 (*Triodia* closed hummock grassland)
- Coastal dunes with *Olearia axillaris* +/- *Westringia dampieri* (BAM sites 2 and 2b),
- Saline clay flat supporting a *Nitraria billardierei* tall shrubland (BAM site 3), and
- Unploughed rocky outcrops within the fallow paddock (BAM site 5 and BAM 6).

Table 3-3 presents the Vegetation Associations recognised at each BAM site and the area mapped within the project boundary. Figure 3-1 shows the location of each BAM survey site. Figure 3-2 shows the area of each vegetation type mapped within the project site boundary. Non-mapped areas did not contain native vegetation.

Table 3-3: BAM site vegetation associations and area (ha) occupied within the project site.

BAM Site	Association/habitat	Area (ha)
1	*Lomandra effusa* (Scented Mat-rush) sedgeland on rocky slopes above coast	1.5
1a	*Lomandra effusa* (Scented Mat-rush) very open sedgeland on rocky slopes above coast	0.69
2	*Olearia axillaris* (Coast Daisy-bush) very open shrubland on coastal hind dunes	4.3
2b	*Olearia axillaris* (Coast Daisy-bush) – *Westringia dampieri* (Shore Westringia) open shrubland on coastal fore dunes	1.2
3	*Nitraria billardierei* (Nitre-bush) Tall Open Shrubland	5.6
4	*Triodia scariosa* (Spinifex) closed hummock grassland	0.63
5	*Asphodelus fistulosus* (Onion Weed) open herbland	5.9
6	*Lomandra effusa* (Scented Mat-rush) +/- *Gahnia lanigera* (Black Grass Saw-sedge) +/- *Lepidosperma* sp. (Rapier Sedge) sedgeland on rocky outcrops in fallow paddock	1.2

Species recorded in 2008 and 2019 within the four habitat types are presented in Table 3-10.

Figure 3-1: Location of Bushland Assessment Method (BAM) sites within project site

Figure 3-2: Vegetation Association mapping across the Project site

Descriptions of each vegetation association identified on site are provided below.

3.6.1 Rocky slopes above beach: Hummock Grasslands and Iron-grass "grasslands"

The 2019 vegetation assessment identified two distinct vegetation associations on the rock slopes above the beach/cliffs:

- *Lomandra effusa* (Scented Iron-grass) tussock grassland and
- *Triodia scariosa* (Spinifex) hummock grassland.

This coincides with DEW extant mapping within the project footprint (NatureMaps 2019).

BAM site 1: *Lomandra effusa* (Scented Iron-grass) tussock grassland.

Lomandra effusa cover varied from an estimated 10 to 30%, with plants averaging about 0.5 m tall. *Maireana brevifolia* (Short-leaf Bluebush) and *Enchylaena tomentosa* (Ruby Saltbush) were also about 0.5 m tall (or less) but estimated to have a projected foliage cover of < 5% each. Refer to Plate 2.

Annual herbs and grass weed species were the dominant ground cover, with *Arctotheca calendula* (Capeweed) estimated to have the highest cover. There were approximately 30 *Lycium ferocissimum* (African Boxthorn) within the 1 hectare survey site (generally < 1 m tall).

Plate 2: *Lomandra effusa* was the dominant overstorey plant. The ground layer was dominated by annual grass and herb weeds.

BAM site 1a: *Lomandra effusa* (Scented Iron-grass) very open tussock grassland on rocky slopes above coast

This community occurred immediately above the cliff top and comprised sparse *Lomandra effusa* with very low native plant diversity and cover. Groundcover was dominated by introduced herbs and grasses, particularly Barley grass (*Hordeum* sp.) and Medics (*Medicago* species).

BAM site 4: *Triodia scariosa* (Spinifex) hummock grassland

This site was characterised by dense *Triodia scariosa* (> 70% cover) with *Maireana brevifolia*, *Enchylaena tomentosa* and *Lomandra effusa* each having a cover of up to 5%. Several annual native species were also present. Refer to Plate 3.

Plate 3: BAM site 4 was characterised by a dense cover (> 70%) of *Triodia scariosa* (Spinifex/Porcupine Grass)

Comparison with Golders Associates (2009)

The 2008 survey site was near the boundary of BAM sites 1 and 4 and was determined to be an *Enchylaena tomentosa – Maireana brevifolia* low shrubland over *Lomandra effusa* and *Triodia irritans* (taxonomy now thought to be *Triodia scariosa*). Refer to Plate 4. Hence the site is likely to have covered part of both BAM sites 1 and 4.

Plate 4: 2008 survey site labelled LIP-001. In 2008 this was described as a low shrubland over *Lomandra effus*a and *Triodia scariosa.*

Changes in *Lomandra effusa* and/or *Triodia scariosa* 2008 – 2019

In 2008, *Enchylaena tomentosa* (Ruby Saltbush) was estimated to cover > 25% of the survey site, compared with < 5% cover in 2019. Conversely, the 2019 survey recorded a higher cover of *Triodia scariosa* (Spinifex Grass) (up to 75%) compared with 26 – 50% cover in 2008. The highly invasive Marguerite daisy was recorded from this habitat only in 2019. The abundance of Boxthorn also appears to have increased from 2008 to 2019. In 2008, African Boxthorn was stated to occur "in very small numbers" at survey site LIP-001 (Golder Associates 2009). In 2019, at least 30 Boxthorn were recorded in the 1 ha BAM site 1.

The higher number of native species recorded in 2019 (35 compared with 18 on 2008) is likely a combination of more annual species being evident due to the time of year surveyed, and a greater area surveyed (the two BAM sites were one hectare each, compared with 0.09 ha for the one Biological Survey of SA site).

Table 3-4 contains plant species recorded in 2008 and 2019 in the rocky slopes adjoining the coast.

Table 3-4: Cover/Abundance of plant species on rocky slopes above beach

Scientific Name	Common Name	Cover/ Abundance*		
		2008 SITE 001	2019 BAM 1	2019 BAM 4
NATIVE				
Austrostipa sp.	Spear-grass		1	1
Brachyscome lineariloba	Hard-head Daisy		1	1
Calandrinia calyptrata	Pink Purslane		1	
Crassula colorata	Dense Crassula		1	1
Einadia nutans.	Climbing Saltbush		1	1
Enchylaena tomentosa	Ruby Saltbush	4	2	2
Gahnia lanigera	Black Grass Saw-sedge			1
Glycine rubiginosa	Twining Glycine		1	1
Hyalosperma demissum	Dwarf Sunray		1	
Lomandra effusa	Scented Mat-rush	3	3	2
Maireana brevifolia	Short-leaf Bluebush	3	2	2
Microseris lanceolata	Yam Daisy		1	
Oxalis perennans	Native Sorrel		1	
Ptilotus seminudus	Rabbit-tails	1		
Rytidosperma sp.	Wallaby-grass		1	
Salsola australis	Buckbush	1	1	
Senecio glossanthus	Annual Groundsel		2	2
Stackhousia monogyna	Creamy Candles		1	1
Thysanotus patersonii	Twining Fringe-lily			1
Triodia scariosa	Spinifex	4	2	5
Wahlenbergia sp.	Native Bluebell		1	1
INTRODUCED				
Aizoon pubescens	Coastal Galenia	1	1	1
Arctotheca calendula	Cape Weed		3	3
Argyranthemum frutescens	Marguerite Daisy			1

Scientific Name	Common Name	Cover/ Abundance*		
		2008 SITE 001	2019 BAM 1	2019 BAM 4
Asphodelus fistulosus	Onion Weed	1	1	1
Avena barbata	Bearded Oat	1	1	1
Brassica tournefortii	Wild Turnip	1	1	1
Bromus rubens	Red Brome	3	1	2
Hordeum glaucum	Blue Barley-grass		2	1
Hypochaeris glabra	Smooth Cat's Ear		2	2
Lamarckia aurea	Toothbrush Grass		1	
Lycium ferocissimum	African Boxthorn	1	1	1
Lysimachia arvensis	Pimpernel			1
Medicago polymorpha	Burr-medic	1	3	2
Medicago truncatula	Barrel Medic		1	1
Mesembryanthemum crystallinum	Common Iceplant	1	1	1
Mesembryanthemum nodiflorum	Slender Iceplant		1	1
Moraea setifolia	Thread Iris		1	
Oxalis pes-caprae	Soursob		2	
Reichardia tingitana	False Sowthistle		1	1
Sonchus oleraceus	Common Sow-thistle		1	1

*Cover/Abundance codes

1 = < 1% cover; 2 = 1 – 5%; 3 = 6 – 25%; 4 = 26 – 50%; 5 =51 – 75%

3.6.2 Coastal Dunes

The coastal dunes were dominated by *Olearia axillaris* (Coastal Daisy Bush) and in parts, *Westringia dampieri* (Shore Westringia). This habitat comprised:

- More densely spaced coastal shrubs on dunes nearer the coast (BAM site 2b); and
- A taller open shrubland on the hind dunes (BAM site 2).

BAM site 2b: *Olearia axillaris – Westringia dampieri* shrubland

The shrubs averaged about 1 m tall and had a combined foliage cover of 10 – 15%. Regeneration was recorded in Coast Daisy-bush, Coast Cushion-bush, Short-stem Flax-lily and Shore Westringia. Six weed species were recorded: *Euphorbia paralias* (Sea Spurge), *Medicago* spp. (Medic), *Argyranthemum frutescens* (Marguerite Daisy), *Cakile maritima* (Sea Rocket), *Brassica tournefortii* (Wild Turnip) and *Asphodelus fistulosus* (Onion Weed), all with a cover of < 5% each. Refer to Plate 5.

Plate 5: BAM site 2b contained a high cover of both *Westringia dampieri* and *Olearia axillaris*, with several age classes present.

BAM Site 2: *Olearia axillaris* very open shrubland

This vegetation type occurred on the hind dunes. Shrubs were taller, but much less abundant than in BAM site 2b. Only five native species were recorded. Total shrub cover was approximately 5%. The Coast Daisy-bush were old shrubs, often senescent, and no regeneration was recorded. Bare ground was at least 80% of the groundcover. Six weed species were recorded: Sea Spurge, Medic, Marguerite Daisy, Sea Rocket, Wild Turnip and Onion Weed, all with a cover of 1 - 5% each. Refer to Plate 6.

Plate 6: BAM site 2 contained tall, but sparsely populated shrubs, mainly *Olearia axillaris*. The weed, Sea Spurge was locally common. Bare sand comprised greater than 80% of the area.

Comparison with Golder Associates (2009)

The area was described as *Olearia axillaris – Westringia dampieri* shrubland (25 – 50% cover) over Marguerite Daisy, Sea Spurge and *Ficinia nodosa*. Refer to Plate 7.

Plate 7: Tall shrubland at 2008 survey site LIP-002

Changes in coastal dunes 2008 – 2019

Nine native species were recorded in both 2008 and 2019, and possibly of similar cover. No annual native species were recorded at either date. The greatest apparent change is the estimated decline in Marguerite Daisy from 6 – 25% cover in 2008, to < 1% cover in 2019. Table 3-5 contains plant species recorded in 2008 and 2019 in the coastal dunes.

Table 3-5: Cover/Abundance of plant species on coastal dunes

Scientific Name	Common Name	Cover/ Abundance*	
		2008 site 002 & walkover	2019 BAM 2 and 2b
NATIVE			
Atriplex cinerea	Coast Saltbush	1	
Carpobrotus sp.	Pigface		1
Dianella brevicaulis	Short-stem Flax-lily	1	1
Disphyma crassifolium	Round-leaf Pigface		1
Ficinia nodosa	Knobby Club-rush	2	2
Leucophyta brownii	Coast Cushion Bush	1	1
Nitraria billardierei	Nitre-bush	1	
Olearia axillaris	Coast Daisy-bush	4	3
Rhagodia candolleana	Sea-berry Saltbush	1	
Spinifex hirsutus	Rolling Spinifex	1	1
Threlkeldia diffusa	Coast Bonefruit		1
Westringia dampieri	Shore Westringia	1	2
INTRODUCED			
Asphodelus fistulosus	Onion Weed	1	1
Argyranthemum frutescens	Marguerite Daisy	3	1
Brassica tournefortii	Wild Turnip		1
Cakile maritima ssp. *maritima*	Two-horned Sea Rocket	1	1
Euphorbia paralias	Sea Spurge	2	2
Lysimachia arvensis	Pimpernel	1	
Medicago polymorpha	Burr-medic		1
Medicago truncatula	Barrel Medic	1	2
Sonchus oleraceus	Common Sow-thistle		1

*Cover/Abundance codes
1 = < 1% cover; 2 = 1 – 5%; 3 = 6 – 25%; 4 = 26 – 50%; 5 =51 – 75%

3.6.3 Saline shrubland

On the clay flat behind the coastal dune, is a Nitre Bush tall shrubland over samphire.

BAM site 3: *Nitraria billardierei* (Nitre Bush) tall open shrubland

This association occurred on the clay flat behind the dunes. The Nitre bush were old plants. Projective foliage cover varied from approximately 20 to 40%. Vegetated groundcover comprised < 5%, with *Wilsonia rotundifolia* and *Tecticornia pergranulata* estimated to cover 1 – 5% each. Only two other native species were recorded in this area – *Maireana brevifolia* and *Enchylaena tomentosa*. Being a saline area, native species diversity is naturally relatively low. The soil has been pugged by domestic stock and no regeneration was noted in the plants. Refer to Plate 8.

Plate 8: BAM site 3 contained tall shrubs of Nitre-bush (*Nitraria billardierei)* (total cover about 20 – 40%) over a sparse cover of Samphire (*Tecticornia pergranulata*).

Comparison with Golder Associates (2009)

BAM site corresponds with LIP-003 from the 2008 assessment. The area was recorded as *Nitraria billardierei* (Nitre Bush) tall open shrubland over *Tecticornia* sp. (25 – 50% cover). Salt scalding was evident over large areas. Five native and one exotic plant species was recorded.

Plate 9: 2008 survey site photo (LIP-003) showing mid-dense Nitre-bush (*Nitraria billardierei)*

Changes in saline shrubland, 2008 – 2019

There appears to have been little apparent change between 2008 and 2019. Both survey periods recorded only the same five native plant species. There has possibly been a decline in Samphire (*Tecticornia pergranulata*), and an increase in exotic species. Boxthorn was only recorded from this site in 2019. The only weed species recorded in 2008 was Iceplant (*Mesembryanthemum crystallinum*). However, 10 weed species were recorded in 2019, including Boxthorn. Most weed species present in 2019 were annuals, or seasonally evident, which may explain the relative absence of weeds in 2008. Table 3-6 contains plant species recorded in 2008 and 2019 in saline shrubland (on claypan)

Table 3-6: Cover/Abundance of plant species recorded in Saline Shrubland (on claypan)

Scientific Name	Common Name	Golder 3	BAM 3
NATIVE			
Enchylaena tomentosa	Ruby Saltbush	1	1
Nitraria billardierei	Nitre-bush	4	4
Maireana brevifolia	Short-leaf Bluebush	1	1
Wilsonia rotundifolia	Round-leaf Wilsonia	2	2
Tecticornia pergranulata	Black-seed Samphire	4	2 to 3
INTRODUCED			
Asphodelus fistulosus	Onion Weed		1
Mesembryanthemum crystallinum	Common Iceplant	1	2
Sonchus oleraceus	Common Sow-thistle		1
Aizoon pubescens	Coastal Galenia		1
Lamarckia aurea	Toothbrush Grass		1
Lycium ferocissimum	African Boxthorn		1

Scientific Name	Common Name	Golder 3	BAM 3
Reichardia tingitana	False Sowthistle		1
Mesembryanthemum nodiflorum	Slender Iceplant		2
Oxalis pes-caprae	Soursob		2

*Cover/Abundance codes: 1 = < 1% cover; 2 = 1 – 5%; 3 = 6 – 25%; 4 = 26 – 50%; 5 =51 – 75%

3.6.4 Fallow Paddock – rocky outcrops

The fallow paddock comprised exotic species only, except for the rocky outcrops.

BAM site 5: *Asphodelus fistulosus* (Onion Weed) open herbland

Within the fallow paddock, the majority of rocky outcrops supported very sparse native plants of low diversity. At the time of survey these areas were dominated by Onion Weed (*Asphodelus fistulosus*) and Capeweed (*Arctotheca calendula*). Refer to Plate 10 and Plate 11. Eight native species were recorded within BAM 5 sites, over the paddock area.

Plate 10: Rocky outcrops were dominated by Onion Weed (*Asphodelus fistulosus*) and Soursob (*Oxalis pes-caprae*) but contained a very sparse cover of natives, mainly *Maireana brevifolia*

Plate 11: Rocky outcrops were dominated by Onion Weed (*Asphodelus fistulosus*) and Soursob (*Oxalis pes-caprae*) but contained a very sparse cover of natives, mainly *Maireana brevifolia*

Comparison with Golder Associates (2009)

No survey site was done in 2008, but Golder Associates (2009) described the rocky outcrops as being dominated by exotic species, with very sparse natives. Refer to Plate 12.

Plate 12: Photo taken in 2008 of fallow paddock (Golder Associates 2009)

Changes in fallow paddocks 2008 to 2019

There appears to have been no significant changes in native vegetation cover on the rocky outcrop areas in the fallow paddocks. Table 3-7 contains plant species recorded in 2008 and 2019 in fallow paddocks (BAM 5).

Table 3-7: Cover/Abundance of plant species recorded in fallow paddocks (BAM 5)

Scientific Name	Common Name	2019	2008
NATIVE			
Austrostipa sp.	Spear-grass	1	
Atriplex semibaccata	Berry Creeping Saltbush		x
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	1	x
Lomandra effusa	Scented Mat-rush	1	
Maireana brevifolia	Short-leaf Bluebush	1	x
Nitraria billardierei	Nitre-bush	1	
Salsola australis	Buckbush	1	x
Triodia scariosa	Porcupine Grass	1	x
INTRODUCED			
Aizoon pubescens	Coastal Galenia	1	x
Asphodelus fistulosus	Onion Weed	3	x
Avena barbata	Bearded Oat	1	
Brassica tournefortii	Wild Turnip	1	x
Hordeum glaucum	Blue Barley-grass	1	
Lamarckia aurea	Toothbrush Grass	2	
Lycium ferocissimum	African Boxthorn	1	
Mesembryanthemum crystallinum	Common Iceplant	1	x
Oxalis pes-caprae	Soursob	5	

BAM site 6: *Lomandra effusa* (Scented Mat-rush) +/- *Gahnia lanigera* (Black Grass Saw-sedge) +/- *Lepidosperma* sp. (Rapier Sedge) sedgeland on rocky outcrops in fallow paddock

Within the fallow paddock, one rocky outcrop area (BAM 6) was dominated by *Lomandra effusa* (Scented Mat-rush) and, in places *Gahnia lanigera* (Black Grass Saw-sedge) and supported a high diversity and cover of native species. Table 3-8 contains plant species recorded in 2019 in BAM 6.

Table 3-8: Cover/Abundance of plant species recorded in BAM 6

Species	Common Name
NATIVE	
Austrostipa sp.	Spear-grass
Chrysocephalum apiculatum	Common Everlasting
Enchylaena tomentosa var.	Ruby Saltbush
Gahnia lanigera	Black Grass Saw-sedge
Hyalosperma demissum	Dwarf Sunray
Lepidosperma congestum	
Lomandra effusa	Scented Mat-rush
Maireana brevifolia	Short-leaf Bluebush
Rytidosperma sp.	Wallaby-grass
Scleranthus pungens	Prickly Knawel
Senecio pinnatifolius group	Variable Groundsel

Species	Common Name
Stackhousia monogyna	Creamy Candles
Triodia scariosa	Spinifex
Wahlenbergia sp.	Native Bluebell
INTRODUCED	
Arctotheca calendula	Cape Weed
Asphodelus fistulosus	Onion Weed
Brassica tournefortii	Wild Turnip
Bromus rubens	Red Brome
Galenia pubescens var. pubescens	Coastal Galenia
Hordeum glaucum	Blue Barley-grass
Lamarckia aurea	Toothbrush Grass
Lycium ferocissimum	African Boxthorn
Reichardia tingitana	False Sowthistle
Romulea sp.	Onion-grass
Sonchus oleraceus	Common Sow-thistle

3.6.5 Summary comparison of 2008 and 2019 survey sites

Table 3-9 compares species diversity, dominant native and exotic species at surveyed habitats recorded in 2008 and 2019.

Table 3-9: Key features of vegetation associations within project footprint

Habitat	# of species		Dominant native	Dominant exotics	Perceived Changes 2008 to 2019
	native	exotic			
Rocky Slopes					
Nov 2008 Survey site 001	6	8	*Maireana brevifolia* (5-25%) *Enchylaena tomentosa* (25-50%)	Red Brome	Difficult to assess due to different seasonal timing of survey and different sized survey sites. However, perennial native species diversity likely to be at least similar, or greater. Possible increased grazing pressure on *Enchylaena tomentosa*. Increase in high threat environmental weeds: boxthorn and Marguerite daisy
August 2019 BAM 1 and 4	20	20	*Lomandra effusa* (6-25%) OR *Triodia scariosa* (51-75%)	Capeweed, Red Brome, Medics	
Coastal Dunes					
Nov 2008 Survey site 201	9	6	*Olearia axillaris* (26-50%) – *Westringia dampierei* (1-5%)	Marguerite Daisy (5 – 25%), Sea Spurge (<5%)	9 native species recorded during both survey periods. Possible, little change in abundance of individual species
Augusts 2019 BAM 2 and 2b	9	8	*Olearia axillaris* (5-25%) – *Westringia dampierei (1- 5%)*	Medic sp. Sea Spurge (<5%)	
Saline Shrubland					
Nov 2008 Survey site 301	4	1	*Nitraria billardierei* (Nitre-bush) (26 – 50% cover)		Little apparent change in native species composition – possible decline in Black-seed Samphire. Increased reporting of weeds in 2019 may reflect season of survey (most species were annuals), and an actual increase in Boxthorn.
August 2019 BAM 3	4	9	*Nitraria billardierei* (Nitre-bush) (26 – 50% cover)	Iceplant Soursob	
Unploughed rocky reefs in paddock					
Nov 2008 no survey site. Description only	5	4	*Maireana brevifolia* (<1%)	Onion Weed, Wild Turnip	Likely to have been no discernible change.
August 2019 BAM 5	7	9	*Maireana brevifolia* (<1%)	*Soursob* (51-75%), Onion Weed (6 – 25%)	
August 2019 BAM 6	13	11	*Lomandra effusa* (6-25%) *Gahnia lanigera* (1-5%) *Lepidosperma* sp (1-5%)	Boxthorn, Barley Grass, Capeweed	No survey appears to have been done of this rocky outcrop in 2008.

Table 3-10: Native and introduced species recorded by habitat type, in 2008 and 2019.

Habitat: 1 = Rocky slopes (including BAM site 6); 2 = Dunes; 3 = Saline Shrubland; 4 = unploughed rocky reefs

Annual	Scientific Name	Common Name	Habitat recorded 2019	Habitat recorded 2008
	NATIVE			
	Atriplex cinerea	Coast Saltbush		2
	Atriplex semibaccata	Berry Saltbush		4
	Austrostipa sp.	Spear-grass	1,4	
A	*Brachyscome lineariloba*	Hard-head Daisy	1	
A	*Calandrinia calyptrata*	Pink Purslane	1	
	Carpobrotus sp.	Pigface	2	
	Chrysocephalum apiculatum	Common Everlasting	1	
A	*Crassula colorata*	Dense Crassula	1	
	Dianella brevicaulis	Short-stem Flax-lily	2	2
	Disphyma crassifolium ssp.	Round-leaf Pigface	2	
	Einadia nutans ssp.	Climbing Saltbush	1	
	Enchylaena tomentosa var.	Ruby Saltbush	1,3,4	1,3,4
	Ficinia nodosa	Knobby Club-rush	2	2
	Gahnia lanigera	Black Grass Saw-sedge	1	
	Glycine rubiginosa	Twining Glycine	1	
A	*Hyalosperma demissum*	Dwarf Sunray	1	
	Lepidosperma congestum	Rapier Sedge	1	
	Leucophyta brownii	Coast Cushion Bush	2	2
	Lomandra effusa	Scented Mat-rush	1,4	1,4
	Maireana brevifolia	Short-leaf Bluebush	1,3,4	1,3,4
A	*Microseris lanceolata*	Yam Daisy	1	
	Nitraria billardierei	Nitre-bush	3,4	3
	Olearia axillaris	Coast Daisy-bush	2	2
	Oxalis perennans	Native Sorrel	1	
	Ptilotus seminudus	Rabbit-tails		1
	Rhagodia candolleana	Sea-berry Saltbush		2
	Rytidosperma sp.	Wallaby-grass	1	
A	*Salsola australis*	Buckbush	1,4	1,4
	Scleranthus pungens	Prickly Knawel	1	
A	*Senecio glossanthus*	Annual Groundsel	1	
	Spinifex hirsutus	Rolling Spinifex	2	2
A	*Stackhousia monogyna*	Creamy Candles	1	
	Tecticornia pergranulata	Black-seed Samphire	3	3
	Threlkeldia diffusa	Coast Bonefruit	2	
	Thysanotus patersonii	Twining Fringe-lily	1	
	Triodia scariosa	Spinifex	1,4	1,4

Annual	Scientific Name	Common Name	Habitat recorded 2019	Habitat recorded 2008
A	*Wahlenbergia* sp.	Native Bluebell	1	
	Westringia dampieri	Shore Westringia	2	2
	Wilsonia rotundifolia	Round-leaf Wilsonia	3	3
		TOTAL	**35**	**18**
	INTRODUCED			
A	*Aizoon pubescens*	Coastal Galenia	1,3,4	1,4
A	*Arctotheca calendula*	Cape Weed	1	
	Argyranthemum frutescens	Marguerite Daisy	1,2	2
A	*Asphodelus fistulosus*	Onion Weed	1,2,3,4	1,2,4
A	*Avena barbata*	Bearded Oat	1,4	1,4
A	*Brassica tournefortii*	Wild Turnip	1,2,4	1,4
A	*Bromus rubens*	Red Brome	1	1
A	*Cakile maritima* ssp. *maritima*	Two-horned Sea Rocket	2	2
A	*Citrullus* sp.	Wild Melon		4
	Euphorbia paralias	Sea Spurge	2	2
A	*Hordeum glaucum*	Blue Barley-grass	1,4	
A	*Hypochaeris glabra*	Smooth Cat's Ear	1	
A	*Lamarckia aurea*	Toothbrush Grass	1,3,4	
	Lycium ferocissimum	African Boxthorn	1,3,4	1
A	*Lysimachia arvensis*	Pimpernel	1	2
	Marrubium vulgare (D)	Horehound		4
A	*Medicago polymorpha*	Burr-medic	1,2	1
A	*Medicago truncatula*	Barrel Medic	1,2	2
A	*Mesembryanthemum crystallinum*	Common Iceplant	1,3,4	1,3,4
A	*Mesembryanthemum nodiflorum*	Slender Iceplant	1,3	
A	*Moraea setifolia*	Thread Iris	1	
A	*Oxalis pes-caprae*	Soursob	1,3,4	
A	*Reichardia tingitana*	False Sowthistle	1,3	4
A	*Sonchus oleraceus*	Common Sow-thistle	1,2,3	
		TOTAL	22	16

3.7 Lipson Cove Road Vegetation Associations

Two distinct vegetation associations were recognised on the southern side of Lipson Cove Road Reserve. These were assessed by doing two BAM surveys, labelled BAM LCR-1 and BAM LCR-2. The survey site areas are shown in Figure 3-3.

Native plants were absent or not obvious for most of the northern side of the road reserve. Where native plants did occur, these generally comprised low to medium shrubs over an exotic understorey. A qualitative description was made of the dominant plants present.

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BAM survey site areas on Lipson Cove Road

Figure 3-3: BAM survey site areas on Lipson Cove Road

3.7.1 BAM LCR-1: *Acacia pycnantha* (Golden Wattle) – *Allocasuarina verticillata* (Drooping Sheoak) – *Eucalyptus angulosa* (Coast Ridge-fruited Mallee) Low Open Woodland

The above three dominant trees occur at densities varying from very widely spaced to up to about 30% cover, averaging about 10% cover overall. The association occurred along the eastern half of Lipson Cove Road.

The overstorey trees averaged about 4 m tall. The Sheoaks appeared to be relatively young adult trees, and were in good health (refer to Plate 13). It was not apparent whether the Sheoaks had been planted or were naturally occurring. The understorey was dominated by sclerophyll shrubs, particularly *Senna artemisioides* ssp. *artemisioides, Dodonaea viscosa* ssp. *spatulata* and *Templetonia retusa* Annual grass and herb weeds dominated the ground cover, particularly *Brassica tournefortii*, *Hordeum* sp. (Barley Grass), *Arctotheca calendula* (Cape Weed) and *Aizoon pubescens* (Galenia). In general, the canopy extent of trees did not overlap the carriageway, but there were short distances where the canopy overlapped the made road (refer to Plate 15 and Plate 15).

Plate 13: Near the eastern end of Lipson Cove Road. The overstorey trees are Sheoaks, Coast Ridge-fruited Mallee and Golden Wattle, 3 – 4 m tall.

Plate 14: Near the eastern end of Lipson Cove Road.

Plate 15: The southern side of Lipson Cove Road contained a variable cover of mallees, Golden Wattle and Sheoak (= BAM LCR-1) whereas the northern side was largely exotic. This photo shows an area where the tree canopy overlaps the carriageway.

3.7.2 BAM LCR Site 2: Senna very open shrubland with emergent *Eucalyptus gracilis, E. dumosa, E. peninsularis*).

Native shrubs and trees occurred discontinuously, often with large gaps comprised of exotic weeds and grass, particularly, *Avena*, *Hordeum glaucum* and *Salvia verbeneca* (refer to Plate 16).

This site occupied the western half of Lipson Cove Road.

Plate 16: Native vegetation was absent from large areas of BAM LCR-2. Areas of native vegetation tended to be dominated by Senna shrubs, with mallee species occurring only occasionally.

3.7.3 Northern side of Lipson Cove Road

The northern side of Lipson Cove Road contained no, or sparse native species, primarily shrubs. The road appeared to have been relatively recently graded, with the graded road now extending to the edge of shrubs (refer to Plate 17).

Plate 17: The northern side of Lipson Cove Road contained occasional patches of native vegetation, primarily shrubs.

Table 3-11: Plant species recorded in BAM sites Lipson Cove Road: LCR-1 and LCR-2

Scientific Name	Common Name	LCR-1	LCR-2
NATIVE			
Acacia cupularis	Cup Wattle	x	x
Acacia euthycarpa	Wallowa	x	
Acacia halliana	Hall's Wattle	x	
Acacia notabilis	Noable Wattle	x	
Acacia pycnantha	Golden Wattle	x	x
Acacia slerophylla var. sclerophylla	Hard-leaf Wattle	x	x
Allocasuarina verticillata	Drooping Sheoak	x	x
Dianella brevicaulis	Short-stem Flax-lily	x	x
Dodonaea viscosa ssp spatulata	Sticky Hop-bush	x	
Enchylaena tomentosa	Ruby Saltbush	x	x
Eremophila deserti	Turkey-bush		x
Eucalyptus angulosa	Coast Ridge-fruited Mallee	x	
Eucalyptus dumosa	White Mallee	x	x
Eucalyptus gracilis	Yorrell	x	x
Eucalyptus peninsularis	Merrit		x
Lomandra effusa	Scented Mat-rush		x
Maireana brevifolia	Short-leaf Bluebush	x	x

Scientific Name	Common Name	LCR-1	LCR-2
Pittosporum angustifolium	Native Apricot		x
Senna artemisioides ssp. artemisioides	Desert Senna	x	x
Senna artemisioides ssp. filifolia	Fine-leaf Senna	x	x
Templetonia retusa	Cockies Tongue	x	
INTRODUCED			
Aizoon pubescens	Coastal Galenia	2	1
Arctotheca calendula	Cape Weed	2	2
Argyranthemum frutescens	Marguerite Daisy	1	
Asteriscus spinosus	Golden Pallensis	1	
Avena barbata	Bearded oat	3	3
Brassica tournefortii	Wild Turnip	3	1
Hordeum glaucum	Blue Barley-grass	2	3
Reichardia tingitana	False Sowthistle	2	2
Salvia verbeneca	Wild Sage		1
Scabiosa atropurpurea	Scabiosa		2
Schinus molle	Pepper Tree	1	1
Sonchus oleraceus	Common Sow-thistle	2	

3.8 Swaffers Road

The 2008 (Golder Associates 2009) survey provided a qualitative description of Swaffers Road, dividing it into nine segments (refer to Figure 3-4). In August 2019, Jacobs compared the 2008 survey description to vegetation dominants and condition in 2019. This comparison is presented in Table 3-12.

Table 3-12: Swaffers Road Vegetation: comparison 2008 and 2019 survey descriptions

Section	2008 Description	2019 comments
SW1	At the intersection of Swaffers Road and Lincoln Highway is a clay pan (*Tecticornia sp.*). Along the roadsides *Nitraria billardierei* and *Pittosporum angustifolium* are the dominant overstorey species with occasional *Eucalypt* (possibly *E. gracilis*). The understorey comprised *Threlkeldia diffusa, Disphyma crassifolium, Maireana brevifolia, *Brassica tournefortii, *Avena barbata*. Vegetation appears to be naturally occurring	No apparent change. Nitre bush noted as being relatively dense
SW2	The mallee on the northern side of the road at this location has been planted. Along Swaffers road a number of plant species have been planted, including **Eucalyptus utilis* (Platypus Gum) which is endemic to Western Australia. Vouchered specimen of *Acacia notabilis* from southern side of road	No apparent significant change.
SW3	A stand of *Eucalyptus gracilis* with an understorey of *Senna artemisioides* and the occasional *Acacia pycnantha, Acacia euthycarpa, Acacia notabilis* and an individual **Aloe arborescens.*	Stand of *Eucalyptus gracilis* was noted to be quite dense, with dense *Senna artemisioides* in the understorey. Additional species recorded in 2019 that were not documented in 2008 were: *Pittosporum angustifolium, Maireana brevifolia* and *Enchylaena tomentosa*. There were now at least five large *Aloe arborescens* plants present, that provided a dense cover for about 30 m (increased from the one plant recorded in 2008). Mallees on southern side of road are possibly natural (with *Acacia notabilis* present).
SW4	A single row of planted mallee occurs on the northern roadside and extends for approximately 75 m beyond the property entrance that enters from the northern side at the junction of SW3 and SW4. *Pittosporum angustifolium* (Native Apricot) occurs occasionally along this section.	Appears to have been no significant change. No naturally occurring mallees were noted. The groundcover was dominated by exotic herbs and grasses, particularly Oxalis pes-caprae (Soursob), covering up to 50% of the ground. Additional species recorded in 2019 that were not documented in 2019 were: *Dianella brevicaulis* (common) and *Maireana brevifolia* (1 – 5% cover).
SW5	The dominant overstorey species is *Allocasuarina verticillata* (Drooping Sheoak) with most vegetation occurring on the northern roadside. There is a small stand of *Pittosporum angustifolium* (Native Apricot) 125 m from the junction of SW5 and SW6. The ground layer comprised patches of *Avena barbata (Wild Oats), *Dianella brevicaulis* (Coast Flax-lily), **Asphodelus fistulosus* (Onion Weed) and *Maireana brevifolia.*	There may have been an increase in *Allocasuarina verticillata* (Drooping Sheaok). This species occurred in a relatively dense patch over approximately 100 m (up to 50% cover) and abundant regeneration was noted. Understorey species included *Enchylaena tomentosa, Dianella brevicaulis, Einadia nutans, and Maireana brevifolia.* The ground layer was dominated by exotic weeds and grasses, particularly **Brassica tournefortii, *Avena barbata, *Salvia verbeneca.* However, the majority of this section does not contain native trees or shrubs.
SW6	Between Swaffers Road and the farm rubbish dump located within SW6 is a roadside plantation of *Eucalyptus utilis* (Platypus Gum), which appears to be in good condition, and *Melaleuca halmaturorum* (Swamp Paperbark) that is in very	May have been a slight increase in native species. Three *Melaleuca halmaturorum* plants were growing amongst the planted *Eucalyptus utilis*. Naturally occurring *Eucalyptus gracilis* were possibly present (identification

Section	2008 Description	2019 comments
	poor condition. Approximately 50 m towards SW7 is a single row of mallee that is regularly spaced indicating that is has been planted. There is a high percentage of bare ground in this section.	not confirmed due to lack of fruiting material). Other native understorey species noted were: *Enchylaena tomentosa, Atriplex semibaccata, Dianella brevicaulis, Pittosporum angustifolium* and *Acacia farinosa.* Ground cover was largely exotic, particularly *Oxalis pes-caprae* (Soursob), *Aizoon pubescens* (Galenia), *Hordeum sp. (*Barley Grass) and *Brassica tournefortii* (Wild Turnip).
SW7	The vegetation comprised largely ground cover species including *Mesembryanthemum crystallinum, Maireana brevifolia, *Avena barbata and only an occasional mallee *Eucalyptus gracilis, Allocasuarina verticillata* and *Pittosporum angustifolium.*	Appears to have been no significant change. The ratio of native to exotic understorey biomass was <5%. *Hordeum* sp. (Barley grass) covered at least 25% of the ground layer.
SW8	A small patch of native ground cover was represented in this section, approx. 100 m from the boundary between SW7 and SW8. This included a canopy layer of *Allocasuarina verticillata* and *Pittosporum angustifolium.* Plants represented at this location included *Austrostipa elegantissima, Austrostipa nodosa, Rytidosperma caespitosum, Roepera apiculata, Einadia nutans, Enchylaena tomentosa, Vittadinia gracilis* and *Marrubium vulgare*. *Eucalyptus petiolaris* (Eyre Peninsula Blue Gum) was also present.	Appears to have been no significant change. Most native species occur near the western end of this section. Exotic herbs and grasses dominate the understorey, particularly *Oxalis pes-caprae* (Soursob), *Avena barbata* (Wild Oats) *Hordeum sp. (*Barley Grass) and *Brassica tournefortii* (Wild Turnip). NB: In this location the Eyre Peninsula Blue Gum are more likely to have been planted, as this is outside their area of natural occurrence. These trees were in poor health.
SW9	The only vegetation of note is the row of **Pinus halapensis* (Aleppo Pine) on the southern side of Swaffers Road adjacent to the stockyards (large rabbit warren recorded in this area). On the northern side of the road individual specimens of *Nicotiana glauca* (Tree Tobacco) were present. Vegetation along this section of the road is typically dominated by weed and salt tolerant species **Mesembryanthemum crystallinum* (Ice plant), **Avena barbata* (Wild Oats), **Aizoon pubescens* (Galenia) and *Maireana brevifolia* (Short-leaf Bluebush).	Appears to have been no significant change. The ratio of native to exotic understorey biomass was <5%. The only native species recorded were: *Lomandra effusa* (a few plants) and *Maireana brevifolia* (sparse). Prominent exotic species recorded were: *Pinus halapensis, Nicotiana glauca* (<1%), Mesembryanthemum crystallinum, Avena (5 – 25%), *Aizoon pubescens* (<1%), Arctotheca calendula (1 – 5%)
SW10	Paddocks planted with wheat	No change – no native plants present.

Port Spencer Marine Port Development
Location of Swaffers Road Segments

Figure 3-4: Location of Swaffers Road segments.

4. References

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Appendix A. Protected Matters Search Tool Results

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	39
Listed Migratory Species:	38

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	79
Whales and Other Cetaceans:	11
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	18
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia enterocarpa Jumping-jack Wattle [17615]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
[Acacia pinguifolia](#) Fat-leaved Wattle [5319]	Endangered	Species or species habitat may occur within area
[Caladenia brumalis](#) Winter Spider-orchid [54993]	Vulnerable	Species or species habitat may occur within area
[Caladenia tensa](#) Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area
[Pleuropappus phyllocalymmeus](#) Silver Candles [21123]	Vulnerable	Species or species habitat may occur within area
[Prostanthera calycina](#) West Coast Mintbush, Limestone Mintbush, Red Mintbush [9470]	Vulnerable	Species or species habitat likely to occur within area
[Pultenaea trichophylla](#) Tufted Bush-pea [12715]	Endangered	Species or species habitat may occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Sharks		
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Ardenna carneipes](#) Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
[Diomedea antipodensis](#) Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#) Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel	Endangered	Species or species

Name	Threatened	Type of Presence
[1060]		habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus horridus Shaggy Pipefish, Prickly Pipefish [66244]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.25 136.27

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B. BAM Site Data

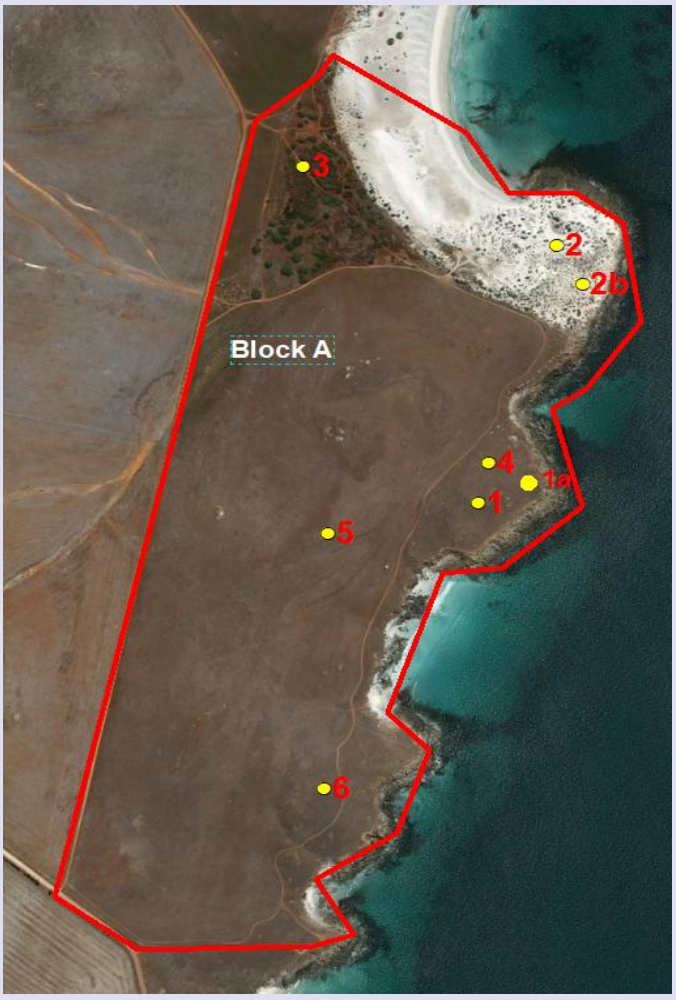
Bushland Assessment Scoresheets

(Version - 1 July 2019)

Block	A
Size of Block (Ha)	47.330
NRM Region	Eyre Peninsula
BCM Region	Eyre Peninsula
IBRA Association	Waretta

ASSESSOR(S)	Sonia Croft
DATE OF ASSESSMENT	29/08/2019

Map of the Block (Including the Sites)



Landscape Context Scores

Percent Vegetation Cover (5km radius) (%)	21
0-5% = 0 pts; >5-10% = 0.01 pts; >10-25% = 0.02 pts; >25-50% = 0.03 pts; >50-75% = 0.01 pt; >75-100% = 0 pts	
Score	0.02

Block Shape Cleared perimeter:Area (km/km2)	
Cleared Perimeter (m) =	1600
Cleared Perimeter to area ratio	3.38
<6 = 0.03 pts; 6 to <12 = 0.02 pts; 12 to <18 = 0.01 pt	
Score	0.03

Note; Blocks will score a minimum Landscape Context Score of 1

% native veg. remaining in IBRA Assoc.	13
0-5% = 0.1 pts; >5-10% = 0.08 pts; >10-20% = 0.06 pts; >20-40%= 0.04 pts; >40-80%= 0.02 pt; >80% = 0 pts	
Score	0.06

% native veg. protected IBRA Assoc.	0
0-5% = 0.03 pts; >5-10% = 0.02 pts; >10-25% = 0.01 pt; >25% = 0	
Score	0.03

Wetland or Riparian Habitat present	
Riparian zone present (Yes/No) = 0.02 pt	No
Swamp/wetland present (Yes/No) = 0.03 pts	No
(Swamp/wetland may be +/- riparian zone)	
Score	0

LANDSCAPE CONTEXT SCORE (max 1.25)	**1.14**

Plant Species Recorded (Native and Introduced)		Listed Species			Natives only		Introduced Species
Species	**Common Name**	**EPBC**	**SA**	**Not in quadrat**	**Regen**	**Annual Herbs** Spring survey	
Enchylaena tomentosa var. tomentosa	Ruby Saltbush						
Calandrinia calyptrata	Pink Purslane						
Hordeum glaucum	Blue Barley-grass						*
Hyalosperma demissum	Dwarf Sunray						
Triodia scariosa	Spinifex						
Mesembryanthemum crystallinum	Common Iceplant						*
Mesembryanthemum nodiflorum	Slender Iceplant						*
Senecio glossanthus	Annual Groundsel						
Maireana brevifolia	Short-leaf Bluebush				Yes		
Lomandra effusa	Scented Mat-rush						
Bromus rubens	Red Brome						*
Hordeum glaucum	Blue Barley-grass						*
Oxalis perennans	Native Sorrel						
Austrostipa sp.	Spear-grass						
Einadia nutans ssp.	Climbing Saltbush						
Salsola australis	Buckbush						
Rytidosperma sp.	Wallaby-grass						
Crassula colorata var.	Dense Crassula						
Glycine rubiginosa	Twining Glycine						
Stackhousia monogyna	Creamy Candles					Yes	
Brachyscome lineariloba	Hard-head Daisy					Yes	
Wahlenbergia sp.	Native Bluebell					Yes	
Microseris lanceolata	Yam Daisy						
Hypochaeris glabra	Smooth Cat's Ear						*
Brassica tournefortii	Wild Turnip						*
Arctotheca calendula	Cape Weed						*
Avena barbata	Bearded Oat						*
Lamarckia aurea	Toothbrush Grass						*
Lycium ferocissimum	African Boxthorn						*
Asphodelus fistulosus	Onion Weed						*
Reichardia tingitana	False Sowthistle						*
Galenia pubescens var. pubescens	Coastal Galenia						*
Oxalis pes-caprae	Soursob						*
Romulea sp.	Onion-grass						*
Medicago polymorpha	Burr-medic						*
Sonchus oleraceus	Common Sow-thistle						*
Medicago truncatula	Barrel Medic						*

Threatened or Introduced Animal Species Recorded or Observed (Native and Introduced)		Threatened Species				Introduced Species
Species	Common Name	EPBC	SA	Past Record	Observed	

Vegetation Condition Scores

SITE:	BAM 1
BCM COMMUNITY	EP 3.2 Grasslands
VEGETATION ASSOCIATION DESCRIPTION	Lomandra effusa open sedgeland
SIZE OF SITE (Ha)	0.007341

Benchmarked attributes
(Scores determined by comparing to a Benchmark community)

Number of Native Species (Minus herbaceous annuals for spring Surveys)	15
Native Plant Species Diversity Score (max 30) from benchmark score *weighted by a factor of 2*	**18.0**
Number of regenerating native species	1
Regeneration Score (max 12) from benchmark community weighted by a factor of 1.5	**4.5**

Weed species (Top 5 Cover x Invasiveness)	Cover (max 6)	Weed Threat Rating (max 5)	C x I
Arctotheca calendula	3	2	6
Lycium ferocissimum	1	4	4
Oxalis pes-caprae	2	3	6
Medicago spp.	3	2	6
Hordeum sp.	2	1	2
	Cover x Threat		24
Weed Score (max 15) from benchmark community			**8**

Native Plant Life Forms	**Cover rating**
Trees > 15m	
Trees 5 - 15 m	
Trees < 5m	
Mallee > 5m	
Mallee < 5m	
Shrubs > 2m	
Shrubs 0.5 - 2m	
Shrubs < 0.5	2
Forbs	2
Mat Plants	
Grasses > 0.2m	
Grasses < 0.2m	2
Sedges > 1m	
Sedges < 1m	3
Hummock grasses	2
Vines, scramblers	1
Mistletoe	
Ferns	
Grass-tree	
Total	12
Native Plant Life Forms (max 20) from benchmark score *weighted by a factor of 2*	**14.0**

Non-Benchmarked Attributes
(Scores determined from direct field observations)

Native:exotic Understorey biomass Score (max 5)	**4**

Is the community naturally treeless?	■
Tree attributes not scored for treeless communities or communities with only emergent trees	

Vegetation Condition Score calculation

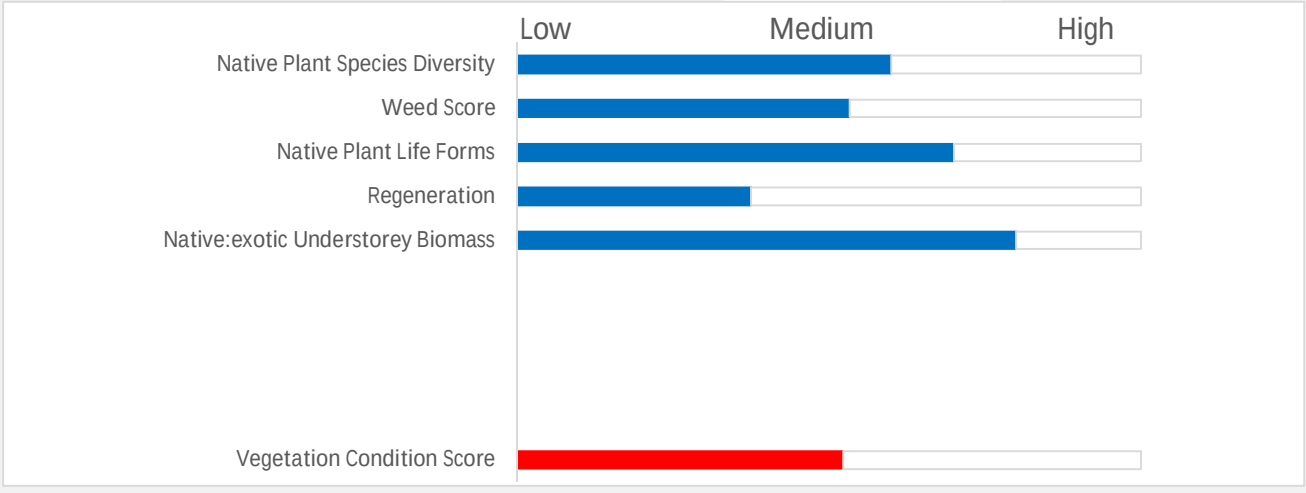
Positive Vegetation Attributes Score = Native species diversity + Regeneration + Native Plant Life Forms Fallen timber/debris + Hollow-bearing trees

- If the community Score is Not Benchmarked (SNB) for regeneration this score is multiplied 1.24

- If the community is naturally treeless this score is multiplied by 1.29 47.09

Negative Vegetation Attributes Score = (15 - Weeds) + ((10 - (Biomass score x 2))exp2/2) 9.00

VEGETATION CONDITION SCORE (Positive veg attributes x ((80 - Negative vegetation attributes) / 80)) **41.79**



Conservation Significance Score

Is the vegetation association considered a Threatened Ecological community or Ecosystem?	Yes/No
State (Provisional List of Threatened Ecosystems of SA) **Rare** community (0.1 pt)	■
State (Provisional List of Threatened Ecosystems of SA) **Vulnerable** community (0.2 pts)	■
State (Provisional List of Threatened Ecosystems of SA) **Endangered** community (0.3 pts)	■
Nationally (EPBC Act) V**ulnerable** community (0.35 pts)	■
Nationally (EPBC Act) **Endangered** or **Critically Endangered** community (0.4 pts)	■
Note; all sites will score a minimum Conservation Significance Score of 1 **Score**	1

Number of Threatened Plant Species recorded for the site (within the site)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species recorded (1 pt each)	0
State **Vulnerable** species recorded (2.5 pt each)	0
State **Endangered** recorded (5 pts each)	0
Nationally **Vulnerable** species recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species recorded (20 pts each)	0
0 = 0 pts; <2 = 0.04 pts; 2 - <5 = 0.08 pts; 5 - <10 = 0.12 pts; 10 - <20 = 0.16 pts; 20 or > = 0.2 pts	**0**
Score	0

Potential habitat for Threatened Animal Species (number observed or previously recorded)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species observed or locally recorded (1 pt each)	0
State **Vulnerable** species observed or locally recorded (2.5 pt each)	0
State **Endangered** species observed or locally recorded (5 pt each)	0
Nationally **Vulnerable** species observed or locally recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species observed or locally recorded (20 pts each)	0
0 = 0 pts; <2 = 0.02 pts; 2 - <5 = 0.04 pts; 5 - <10 = 0.06 pts; 10 - <20 = 0.08pts; 20 or > = 0.1 pts	**0**
Score	0

CONSERVATION SIGNIFICANCE SCORE	**1**

Total Scores for the Site

	Score
LANDSCAPE CONTEXT SCORE	**1.14**
VEGETATION CONDITION SCORE	**41.79**
CONSERVATION SIGNIFICANCE SCORE	**1.00**

Vegetation Condition x Landscape Context x Conservation Significance =	
UNIT BIODIVERSITY SCORE	47.64
Total Biodiversity Score (Biodiversity Score x hectares)	0.35

Photo Point and Vegetation Survey Location	Direction of the Photo
	North
	GPS Reference
	Datum: GDA94
	Zone (52, 53 or 54): 53
	Easting (6 digits): 616682
	Northing (7 digits): 6209639
	Description
	Lomandra effusa grassland

What is the purpose of Assessment? Clearance | SEB Area | Other

Assessment for Clearance

Loss Factor	1.0
Loadings for clearance of protected areas	
Reductions for rehabilitation of impact site	
SEB Points required	**0.37**

Approximate hectares required	0.05
Economies of Scale Factor	1
Mean Annual rainfall for the site (mm)	305
Payment into the fund (GST Exclusive)	**$145.63**
Administration fee (GST Inclusive)	**$8.01**

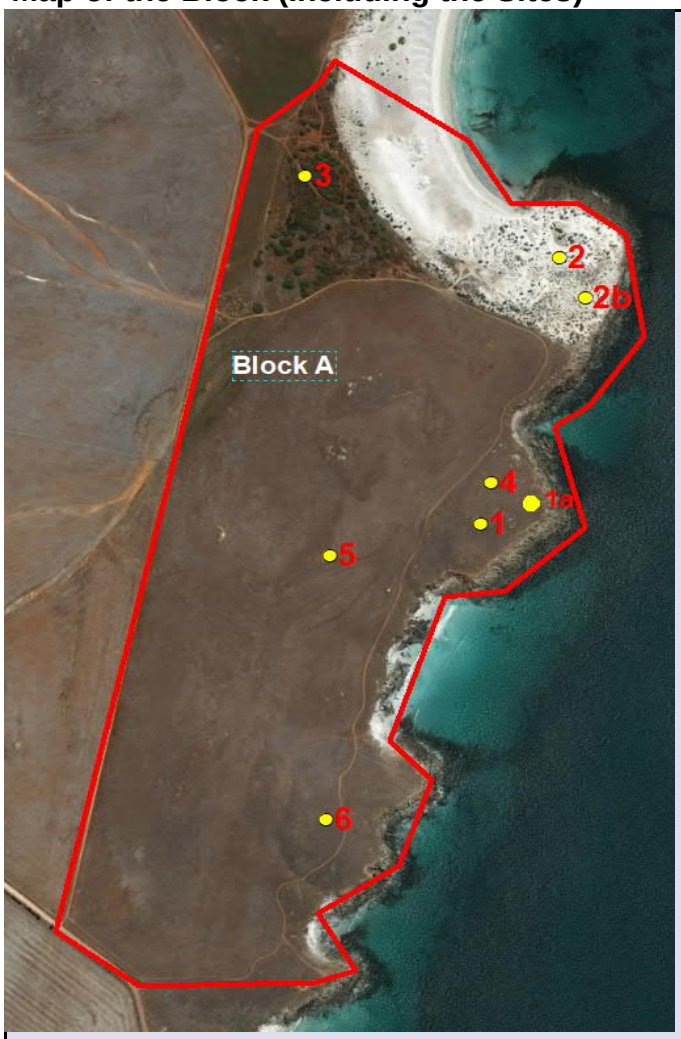
Bushland Assessment Scoresheets

(Version - 1 July 2019)

Block	A
Size of Block (Ha)	47.330
NRM Region	Eyre Peninsula
BCM Region	Eyre Peninsula
IBRA Association	Waretta

ASSESSOR(S)	Sonia Croft
DATE OF ASSESSMENT	29/09/2019

Map of the Block (Including the Sites)



Landscape Context Scores

% native veg. remaining in IBRA Assoc.	13
0-5% = 0.1 pts; >5-10% = 0.08 pts; >10-20% = 0.06 pts; >20-40%= 0.04 pts; >40-80%= 0.02 pt; >80% = 0 pts	
Score	0.06

Percent Vegetation Cover (5km radius) (%)	21
0-5% = 0 pts; >5-10% = 0.01 pts; >10-25% = 0.02 pts; >25-50% = 0.03 pts; >50-75% = 0.01 pt; >75-100% = 0 pts	
Score	0.02

% native veg. protected IBRA Assoc.	0
0-5% = 0.03 pts; >5-10% = 0.02 pts; >10-25% = 0.01 pt; >25% = 0	
Score	0.03

Block Shape Cleared perimeter:Area (km/km2)	
Cleared Perimeter (m) =	1600
Cleared Perimeter to area ratio	3.38
<6 = 0.03 pts; 6 to <12 = 0.02 pts; 12 to <18 = 0.01 pt	
Score	0.03

Wetland or Riparian Habitat present	
Riparian zone present (Yes/No) = 0.02 pt	No
Swamp/wetland present (Yes/No) = 0.03 pts	No
(Swamp/wetland may be +/- riparian zone)	
Score	0

Note; Blocks will score a minimum Landscape Context Score of 1

LANDSCAPE CONTEXT SCORE (max 1.25)	**1.14**

Plant Species Recorded (Native and Introduced)		Listed Species			Natives only		
Species	**Common Name**	**EPBC**	**SA**	**Not in quadrat**	**Regen**	**Annual Herbs** Spring survey	**Introduced Species**
Lomandra effusa	Scented Mat-rush						
Triodia scariosa	Spinifex						
Maireana brevifolia	Short-leaf Bluebush						
Senecio glossanthus	Annual Groundsel						

Threatened or Introduced Animal Species Recorded or Observed (Native and Introduced)		Threatened Species				Introduced Species
Species	Common Name	EPBC	SA	Past Record	Observed	

Vegetation Condition Scores

SITE:	1a
BCM COMMUNITY	EP 3.2 Grasslands
VEGETATION ASSOCIATION DESCRIPTION	Lomandra effusa very open sedgeland
SIZE OF SITE (Ha)	0.131795

Benchmarked attributes
(Scores determined by comparing to a Benchmark community)

Number of Native Species (Minus herbaceous annuals for spring Surveys)	4
Native Plant Species Diversity Score (max 30) from benchmark score *weighted by a factor of 2*	**4.0**
Number of regenerating native species	0
Regeneration Score (max 12) from benchmark community weighted by a factor of 1.5	**0**

Weed species (Top 5 Cover x Invasiveness)	Cover (max 6)	Weed Threat Rating (max 5)	C x I
Hordeum sp.	4	1	4
Medicago spp.	3	2	6
Arctotheca calendula	2	2	4
Oxalis pes-caprae	2	3	6
Lycium ferocissimum	1	4	4
	Cover x Threat		24
Weed Score (max 15) from benchmark community			**8**

Native Plant Life Forms	**Cover rating**
Trees > 15m	
Trees 5 - 15 m	
Trees < 5m	
Mallee > 5m	
Mallee < 5m	
Shrubs > 2m	
Shrubs 0.5 - 2m	1
Shrubs < 0.5	
Forbs	
Mat Plants	
Grasses > 0.2m	
Grasses < 0.2m	
Sedges > 1m	
Sedges < 1m	1
Hummock grasses	1
Vines, scramblers	
Mistletoe	
Ferns	
Grass-tree	
Total	3

Native Plant Life Forms (max 20) from benchmark score *weighted by a factor of 2* **2.0**

Non-Benchmarked Attributes
(Scores determined from direct field observations)

Native:exotic Understorey biomass Score (max 5)	**1**

Is the community naturally treeless?	☑
Tree attributes not scored for treeless communities or communities with only emergent trees	

Vegetation Condition Score calculation

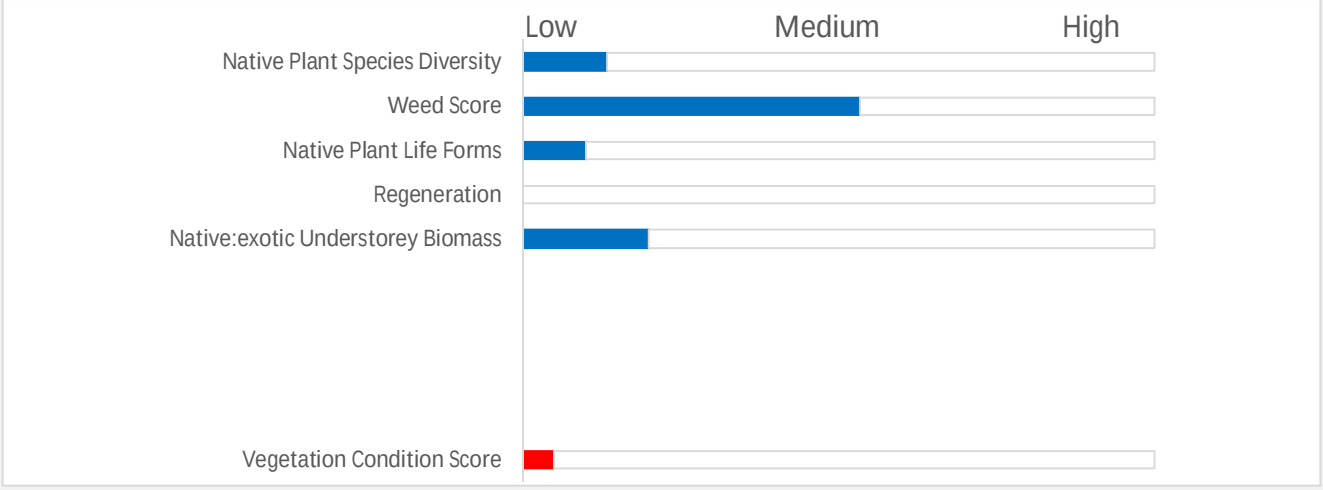
Positive Vegetation Attributes Score = Native species diversity + Regeneration + Native Plant Life Forms
Fallen timber/debris + Hollow-bearing trees

- If the community Score is Not Benchmarked (SNB) for regeneration this score is multiplied 1.24

- If the community is naturally treeless this score is multiplied by 1.29 7.74

Negative Vegetation Attributes Score = (15 - Weeds) + ((10 - (Biomass score x 2))exp2/2) 39.00

VEGETATION CONDITION SCORE (Positive veg attributes x ((80 - Negative vegetation attributes) / 80)) **3.97**



Conservation Significance Score

Is the vegetation association considered a Threatened Ecological community or Ecosystem?	Yes/No
State (Provisional List of Threatened Ecosystems of SA) **Rare** community (0.1 pt)	☐
State (Provisional List of Threatened Ecosystems of SA) **Vulnerable** community (0.2 pts)	☐
State (Provisional List of Threatened Ecosystems of SA) **Endangered** community (0.3 pts)	☐
Nationally (EPBC Act) V**ulnerable** community (0.35 pts)	☐
Nationally (EPBC Act) **Endangered** or **Critically Endangered** community (0.4 pts)	☐
Note; all sites will score a minimum Conservation Significance Score of 1 **Score**	1

Number of Threatened Plant Species recorded for the site (within the site)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species recorded (1 pt each)	0
State **Vulnerable** species recorded (2.5 pt each)	0
State **Endangered** recorded (5 pts each)	0
Nationally **Vulnerable** species recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species recorded (20 pts each)	0
0 = 0 pts; <2 = 0.04 pts; 2 - <5 = 0.08 pts; 5 - <10 = 0.12 pts; 10 - <20 = 0.16 pts; 20 or > = 0.2 pts	**0**
Score	0

Potential habitat for Threatened Animal Species (number observed or previously recorded)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species observed or locally recorded (1 pt each)	0
State **Vulnerable** species observed or locally recorded (2.5 pt each)	0
State **Endangered** species observed or locally recorded (5 pt each)	0
Nationally **Vulnerable** species observed or locally recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species observed or locally recorded (20 pts each)	0
0 = 0 pts; <2 = 0.02 pts; 2 - <5 = 0.04 pts; 5 - <10 = 0.06 pts; 10 - <20 = 0.08pts; 20 or > = 0.1 pts	**0**
Score	0
CONSERVATION SIGNIFICANCE SCORE	**1**

Total Scores for the Site

	Score
LANDSCAPE CONTEXT SCORE	**1.14**
VEGETATION CONDITION SCORE	**3.97**
CONSERVATION SIGNIFICANCE SCORE	**1.00**

Vegetation Condition x Landscape Context x Conservation Significance =	
UNIT BIODIVERSITY SCORE	4.52
Total Biodiversity Score (Biodiversity Score x hectares)	0.60

Photo Point and Vegetation Survey Location	Direction of the Photo
	GPS Reference
	Datum
	Zone (52, 53 or 54)
	Easting (6 digits)
	Northing (7 digits)
	Description

What is the purpose of Assessment? Clearance SEB Area Other

Assessment for Clearance

Loss Factor	1.0
Loadings for clearance of protected areas	
Reductions for rehabilitation of impact site	
SEB Points required	**0.63**

Approximate hectares required	0.08
Economies of Scale Factor	0.5
Mean Annual rainfall for the site (mm)	305
Payment into the fund (GST Exclusive)	**$248.18**
Administration fee (GST Inclusive)	**$13.65**

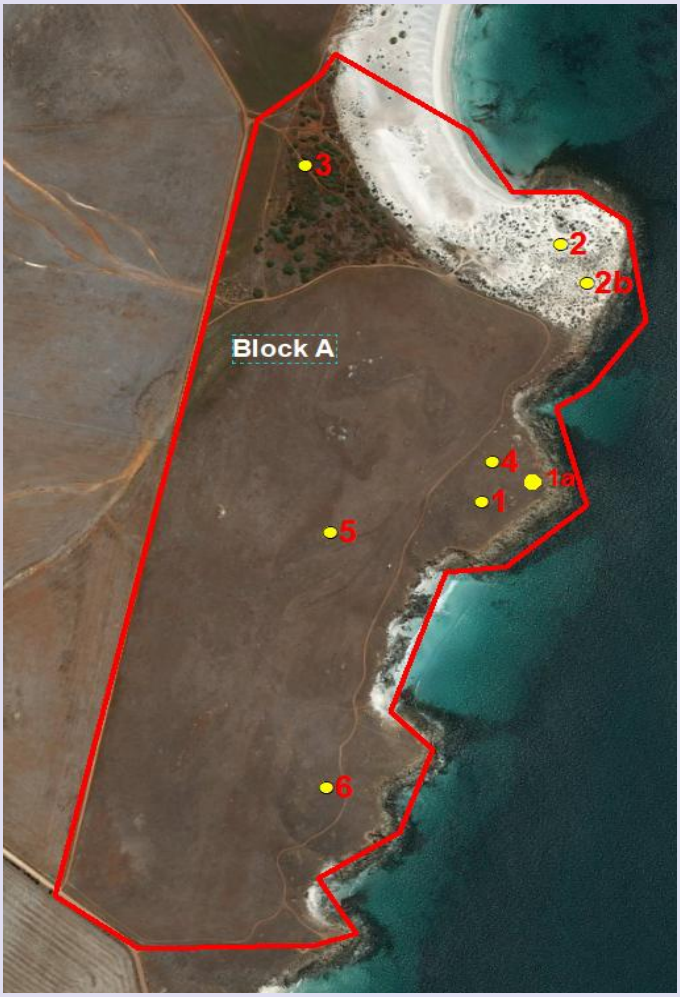
Bushland Assessment Scoresheets

(Version - 1 July 2019)

Block	A
Size of Block (Ha)	47.330
NRM Region	Eyre Peninsula
BCM Region	Eyre Peninsula
IBRA Association	Waretta

ASSESSOR(S)	Sonia Croft
DATE OF ASSESSMENT	29/08/2019

Map of the Block (Including the Sites)



Landscape Context Scores

Percent Vegetation Cover (5km radius) (%)	21
0-5% = 0 pts; >5-10% = 0.01 pts; >10-25% = 0.02 pts; >25-50% = 0.03 pts; >50-75% = 0.01 pt; >75-100% = 0 pts	
Score	0.02

Block Shape Cleared perimeter:Area (km/km2)	
Cleared Perimeter (m) =	1600
Cleared Perimeter to area ratio	3.38
<6 = 0.03 pts; 6 to <12 = 0.02 pts; 12 to <18 = 0.01 pt	
Score	0.03

Note; Blocks will score a minimum Landscape Context Score of 1

% native veg. remaining in IBRA Assoc.	13
0-5% = 0.1 pts; >5-10% = 0.08 pts; >10-20% = 0.06 pts; >20-40%= 0.04 pts; >40-80%= 0.02 pt; >80% = 0 pts	
Score	0.06

% native veg. protected IBRA Assoc.	0
0-5% = 0.03 pts; >5-10% = 0.02 pts; >10-25% = 0.01 pt; >25% = 0	
Score	0.03

Wetland or Riparian Habitat present	
Riparian zone present (Yes/No) = 0.02 pt	No
Swamp/wetland present (Yes/No) = 0.03 pts	No
(Swamp/wetland may be +/- riparian zone)	
Score	0

LANDSCAPE CONTEXT SCORE (max 1.25)	**1.14**

Plant Species Recorded (Native and Introduced)		Listed Species			Natives only		
Species	**Common Name**	**EPBC**	**SA**	**Not in quadrat**	**Regen**	**Annual Herbs** Spring survey	**Introduced Species**
Nitraria billardierei	Nitre-bush						
Wilsonia rotundifolia	Round-leaf Wilsonia						
Tecticornia pergranulata ssp.	Black-seed Samphire						
Maireana brevifolia	Short-leaf Bluebush						
Enchylaena tomentosa var.	Ruby Saltbush						
Mesembryanthemum crystallinum	Common Iceplant						*
Mesembryanthemum nodiflorum	Slender Iceplant						*
Oxalis pes-caprae	Soursob						*
Reichardia tingitana	False Sowthistle						*
Lycium ferocissimum	African Boxthorn						*
Hordeum sp.	#N/A	#N/A	#N/A				#N/A
Lamarckia aurea	Toothbrush Grass						*
Galenia pubescens var. pubescens	Coastal Galenia						*
Asphodelus fistulosus	Onion Weed						*
Sonchus oleraceus	Common Sow-thistle						*

Threatened or Introduced Animal Species Recorded or Observed (Native and Introduced)		Threatened Species				Introduced Species
Species	Common Name	EPBC	SA	Past Record	Observed	

Vegetation Condition Scores

SITE:	BAM 3
BCM COMMUNITY	EP 13.2 Samphire or Chenopod Shrublands with Infrequent Inundation /Saline Soils
VEGETATION ASSOCIATION DESCRIPTION	Nitraria billardierei tall shrubland
SIZE OF SITE (Ha)	0.442372

Benchmarked attributes
(Scores determined by comparing to a Benchmark community)

Number of Native Species (Minus herbaceous annuals for spring Surveys)	6
Native Plant Species Diversity Score (max 30) from benchmark score *weighted by a factor of 2*	**18.0**
Number of regenerating native species	0
Regeneration Score (max 12) from benchmark community weighted by a factor of 1.5	**0**

Weed species (Top 5 Cover x Invasiveness)	Cover (max 6)	Weed Threat Rating (max 5)	C x I
Mesembryanthemum crystallinum	2	2	4
mesembryanthemum nodiflorum	2	2	4
Lycium ferocissimum	1	4	4
Oxalis pes-caprae	2	3	6
Hordeum sp.	2	1	2
	Cover x Threat		20
Weed Score (max 15) from benchmark community			**4**

Native Plant Life Forms	**Cover rating**
Trees > 15m	
Trees 5 - 15 m	
Trees < 5m	
Mallee > 5m	
Mallee < 5m	
Shrubs > 2m	2
Shrubs 0.5 - 2m	4
Shrubs < 0.5	2
Forbs	
Mat Plants	2
Grasses > 0.2m	
Grasses < 0.2m	
Sedges > 1m	
Sedges < 1m	
Hummock grasses	
Vines, scramblers	
Mistletoe	
Ferns	
Grass-tree	
Total	10
Native Plant Life Forms (max 20) from benchmark score *weighted by a factor of 2*	**16.0**

Non-Benchmarked Attributes
(Scores determined from direct field observations)

Native:exotic Understorey biomass Score (max 5)	**5**

Is the community naturally treeless?	☑
Tree attributes not scored for treeless communities or communities with only emergent trees	

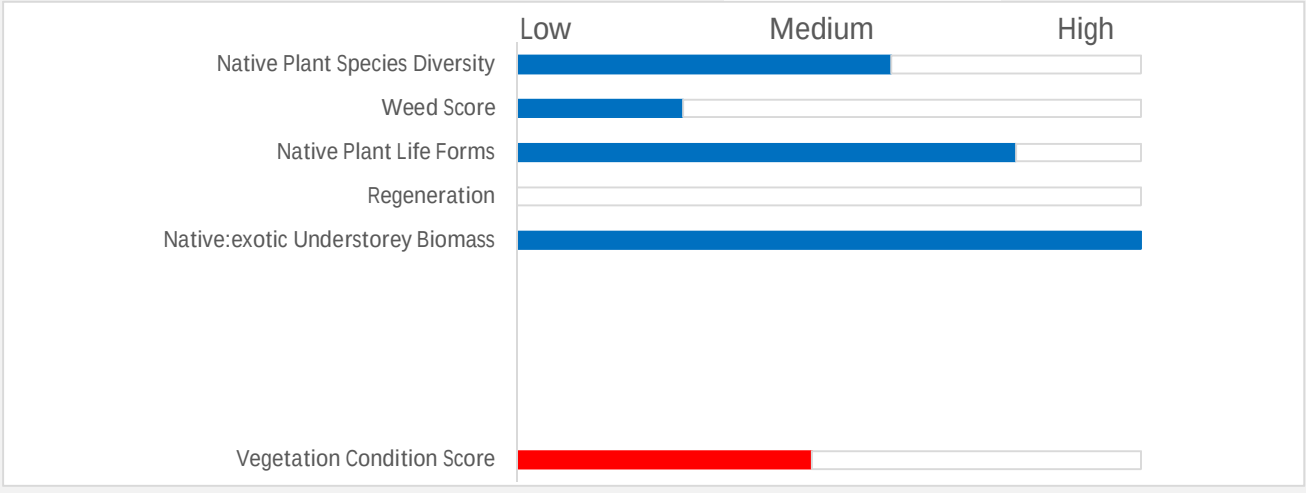
Vegetation Condition Score calculation

Positive Vegetation Attributes Score = Native species diversity + Regeneration + Native Plant Life Forms Fallen timber/debris + Hollow-bearing trees

- If the community Score is Not Benchmarked (SNB) for regeneration this score is multiplied 1.24

- If the community is naturally treeless this score is multiplied by 1.29

	43.86
Negative Vegetation Attributes Score = (15 - Weeds) + ((10 - (Biomass score x 2))exp2/2)	11.00
VEGETATION CONDITION SCORE (Positive veg attributes x ((80 - Negative vegetation attributes) / 80))	**37.83**



Conservation Significance Score

Is the vegetation association considered a Threatened Ecological community or Ecosystem?	Yes/No
State (Provisional List of Threatened Ecosystems of SA) **Rare** community (0.1 pt)	☐
State (Provisional List of Threatened Ecosystems of SA) **Vulnerable** community (0.2 pts)	☐
State (Provisional List of Threatened Ecosystems of SA) **Endangered** community (0.3 pts)	☐
Nationally (EPBC Act) V**ulnerable** community (0.35 pts)	☐
Nationally (EPBC Act) **Endangered** or **Critically Endangered** community (0.4 pts)	☐
Note; all sites will score a minimum Conservation Significance Score of 1 **Score**	1

Number of Threatened Plant Species recorded for the site (within the site)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species recorded (1 pt each)	0
State **Vulnerable** species recorded (2.5 pt each)	0
State **Endangered** recorded (5 pts each)	0
Nationally **Vulnerable** species recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species recorded (20 pts each)	0
0 = 0 pts; <2 = 0.04 pts; 2 - <5 = 0.08 pts; 5 - <10 = 0.12 pts; 10 - <20 = 0.16 pts; 20 or > = 0.2 pts	**0**
Score	0

Potential habitat for Threatened Animal Species (number observed or previously recorded)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species observed or locally recorded (1 pt each)	0
State **Vulnerable** species observed or locally recorded (2.5 pt each)	0
State **Endangered** species observed or locally recorded (5 pt each)	0
Nationally **Vulnerable** species observed or locally recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species observed or locally recorded (20 pts each)	0
0 = 0 pts; <2 = 0.02 pts; 2 - <5 = 0.04 pts; 5 - <10 = 0.06 pts; 10 - <20 = 0.08pts; 20 or > = 0.1 pts	**0**
Score	0

CONSERVATION SIGNIFICANCE SCORE	**1**

Total Scores for the Site

	Score
LANDSCAPE CONTEXT SCORE	**1.14**
VEGETATION CONDITION SCORE	**37.83**
CONSERVATION SIGNIFICANCE SCORE	**1.00**

Vegetation Condition x Landscape Context x Conservation Significance =	
UNIT BIODIVERSITY SCORE	43.13
Total Biodiversity Score (Biodiversity Score x hectares)	19.08

Photo Point and Vegetation Survey Location

Direction of the Photo

GPS Reference

Datum	GDA94
Zone (52, 53 or 54)	53
Easting (6 digits)	616438
Northing (7 digits)	6210246

Description

BAM site 3 contained tall shrubs of Nitre-bush (Nitraria billardierei) (total cover about 30 – 40%) over a sparse cover of Samphire (Tecticornia pergranulata).

What is the purpose of Assessment? Clearance SEB Area Other

Assessment for Clearance

Loss Factor	1.0
Loadings for clearance of protected areas	
Reductions for rehabilitation of impact site	
SEB Points required	**20.03**

Approximate hectares required	2.50
Economies of Scale Factor	0.5
Mean Annual rainfall for the site (mm)	305
Payment into the fund (GST Exclusive)	**$7,944.33**
Administration fee (GST Inclusive)	**$436.94**

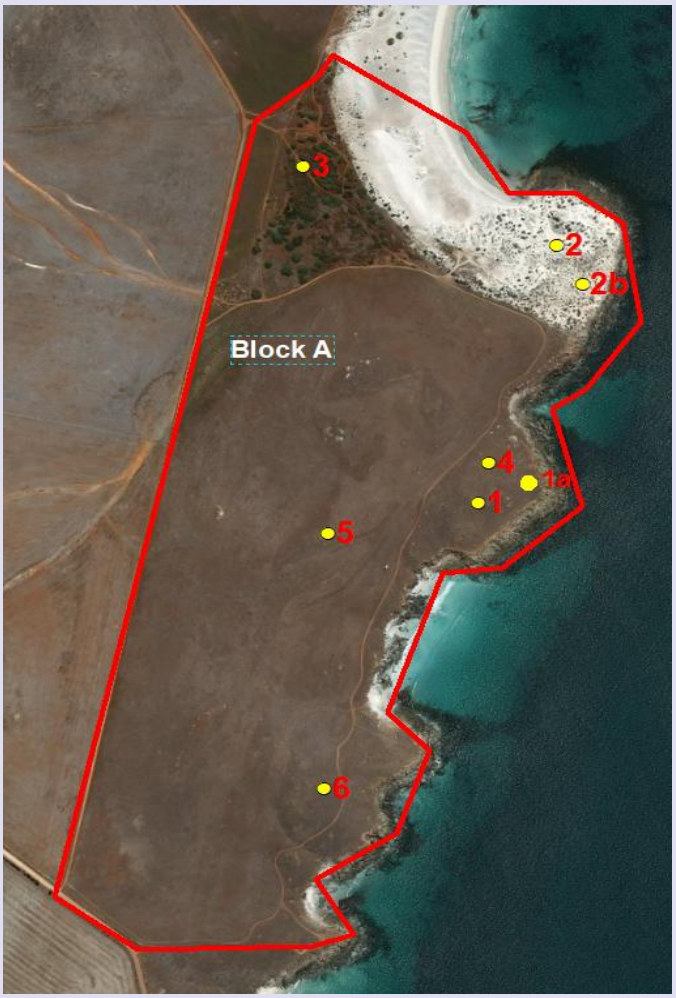
Bushland Assessment Scoresheets

(Version - 1 July 2019)

Block	A
Size of Block (Ha)	47.330
NRM Region	Eyre Peninsula
BCM Region	Eyre Peninsula
IBRA Association	Waretta

ASSESSOR(S)	Sonia Croft
DATE OF ASSESSMENT	29/08/2019

Map of the Block (Including the Sites)



Landscape Context Scores

% native veg. remaining in IBRA Assoc.	13
0-5% = 0.1 pts; >5-10% = 0.08 pts; >10-20% = 0.06 pts; >20-40%= 0.04 pts; >40-80%= 0.02 pt; >80% = 0 pts	
Score	0.06

Percent Vegetation Cover (5km radius) (%)	21
0-5% = 0 pts; >5-10% = 0.01 pts; >10-25% = 0.02 pts; >25-50% = 0.03 pts; >50-75% = 0.01 pt; >75-100% = 0 pts	
Score	0.02

% native veg. protected IBRA Assoc.	0
0-5% = 0.03 pts; >5-10% = 0.02 pts; >10-25% = 0.01 pt; >25% = 0	
Score	0.03

Block Shape Cleared perimeter:Area (km/km2)	
Cleared Perimeter (m) =	1600
Cleared Perimeter to area ratio	3.38
<6 = 0.03 pts; 6 to <12 = 0.02 pts; 12 to <18 = 0.01 pt	
Score	0.03

Wetland or Riparian Habitat present	
Riparian zone present (Yes/No) = 0.02 pt	No
Swamp/wetland present (Yes/No) = 0.03 pts	No
(Swamp/wetland may be +/- riparian zone)	
Score	0

Note; Blocks will score a minimum Landscape Context Score of 1

LANDSCAPE CONTEXT SCORE (max 1.25)	**1.14**

Plant Species Recorded (Native and Introduced)		Listed Species			Natives only		
Species	**Common Name**	**EPBC**	**SA**	**Not in quadrat**	**Regen**	**Annual Herbs** Spring survey	**Introduced Species**
Triodia scariosa	Spinifex						
Gahnia lanigera	Black Grass Saw-sedge						
Senecio glossanthus	Annual Groundsel						
Enchylaena tomentosa var.	Ruby Saltbush						
Wahlenbergia sp.	Native Bluebell					Yes	
Brachyscome lineariloba	Hard-head Daisy					Yes	
Glycine rubiginosa	Twining Glycine						
Maireana brevifolia	Short-leaf Bluebush						
Lomandra effusa	Scented Mat-rush						
Stackhousia monogyna	Creamy Candles					Yes	
Thysanotus patersonii	Twining Fringe-lily						
Calandrinia calyptrata	Pink Purslane						
Crassula colorata var.	Dense Crassula						
Einadia nutans ssp.	Climbing Saltbush						
Arctotheca calendula	Cape Weed						*
Hypochaeris glabra	Smooth Cat's Ear						*
Brassica tournefortii	Wild Turnip						*
Lycium ferocissimum	African Boxthorn						*
Hordeum glaucum	Blue Barley-grass						*
Reichardia tingitana	False Sowthistle						*
Lysimachia arvensis	Pimpernel						*
Bromus rubens	Red Brome						*
Galenia pubescens var. pubescens	Coastal Galenia						*
Medicago truncatula	Barrel Medic						*
Medicago polymorpha	Burr-medic						*
Asphodelus fistulosus	Onion Weed						*
Argyranthemum frutescens ssp.	Marguerite Daisy						*
Mesembryanthemum nodiflorum	Slender Iceplant						*
Mesembryanthemum crystallinum	Common Iceplant						*
Avena barbata	Bearded Oat						*
Sonchus oleraceus	Common Sow-thistle						*

Threatened or Introduced Animal Species Recorded or Observed (Native and Introduced)		Threatened Species				Introduced Species
Species	Common Name	EPBC	SA	Past Record	Observed	

Vegetation Condition Scores

SITE:	BAM 4
BCM COMMUNITY	EP 3.2 Grasslands
VEGETATION ASSOCIATION DESCRIPTION	Triodia irritans closed hummock grassland
SIZE OF SITE (Ha)	0.283211

Benchmarked attributes
(Scores determined by comparing to a Benchmark community)

Number of Native Species (Minus herbaceous annuals for spring Surveys)	11
Native Plant Species Diversity Score (max 30) from benchmark score *weighted by a factor of 2*	**14.0**
Number of regenerating native species	0
Regeneration Score (max 12) from benchmark community weighted by a factor of 1.5	**0**

Weed species (Top 5 Cover x Invasiveness)	Cover (max 6)	Weed Threat Rating (max 5)	C x I
Arctotheca calendula	3	2	6
Hypochaeris glabra	2	1	2
Lycium ferocissimum	1	4	4
Bromus rubens	2	1	2
Medicago spp.	2	2	4
	Cover x Threat		18
Weed Score (max 15) from benchmark community			**10**

Native Plant Life Forms	**Cover rating**
Trees > 15m	
Trees 5 - 15 m	
Trees < 5m	
Mallee > 5m	
Mallee < 5m	
Shrubs > 2m	
Shrubs 0.5 - 2m	
Shrubs < 0.5	2
Forbs	2
Mat Plants	
Grasses > 0.2m	
Grasses < 0.2m	
Sedges > 1m	
Sedges < 1m	2
Hummock grasses	5
Vines, scramblers	1
Mistletoe	
Ferns	
Grass-tree	
Total	12
Native Plant Life Forms (max 20) from benchmark score *weighted by a factor of 2*	**14.0**

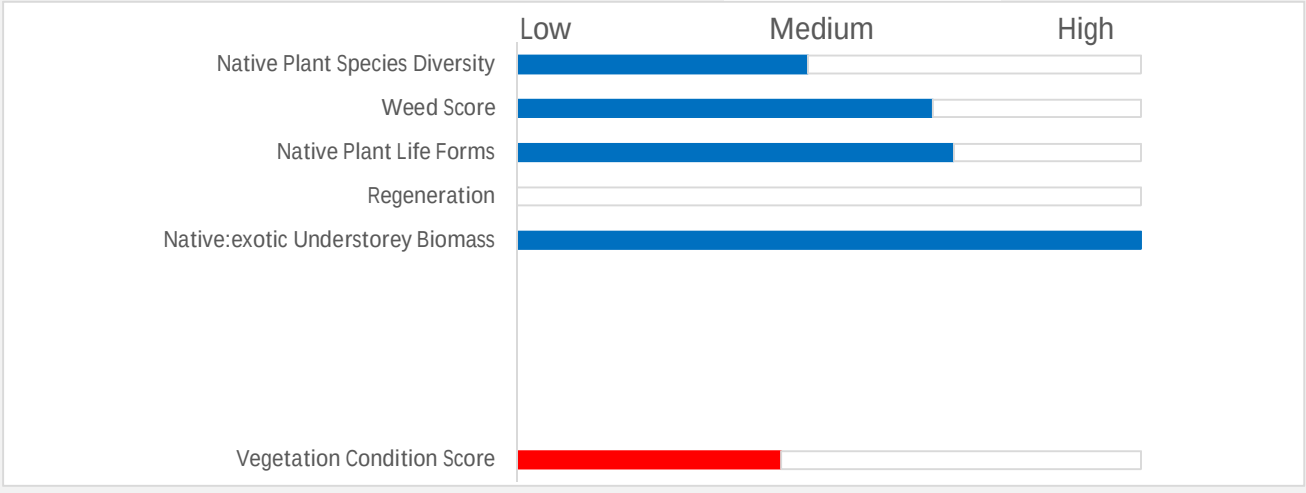
Non-Benchmarked Attributes
(Scores determined from direct field observations)

Native:exotic Understorey biomass Score (max 5)	**5**

Is the community naturally treeless?	☑
Tree attributes not scored for treeless communities or communities with only emergent trees	

Vegetation Condition Score calculation

Positive Vegetation Attributes Score = Native species diversity + Regeneration + Native Plant Life Forms Fallen timber/debris + Hollow-bearing trees *- If the community Score is Not Benchmarked (SNB) for regeneration this score is multiplied 1.24* *- If the community is naturally treeless this score is multiplied by 1.29*	36.12
Negative Vegetation Attributes Score = (15 - Weeds) + ((10 - (Biomass score x 2))exp2/2)	5.00
VEGETATION CONDITION SCORE (Positive veg attributes x ((80 - Negative vegetation attributes) / 80))	**33.86**



Conservation Significance Score

Is the vegetation association considered a Threatened Ecological community or Ecosystem?	Yes/No
State (Provisional List of Threatened Ecosystems of SA) **Rare** community (0.1 pt)	☐
State (Provisional List of Threatened Ecosystems of SA) **Vulnerable** community (0.2 pts)	☐
State (Provisional List of Threatened Ecosystems of SA) **Endangered** community (0.3 pts)	☐
Nationally (EPBC Act) V**ulnerable** community (0.35 pts)	☐
Nationally (EPBC Act) **Endangered** or **Critically Endangered** community (0.4 pts)	☐
Note; all sites will score a minimum Conservation Significance Score of 1 **Score**	1

Number of Threatened Plant Species recorded for the site (within the site)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species recorded (1 pt each)	0
State **Vulnerable** species recorded (2.5 pt each)	0
State **Endangered** recorded (5 pts each)	0
Nationally **Vulnerable** species recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species recorded (20 pts each)	0
0 = 0 pts; <2 = 0.04 pts; 2 - <5 = 0.08 pts; 5 - <10 = 0.12 pts; 10 - <20 = 0.16 pts; 20 or > = 0.2 pts	**0**
Score	0

Potential habitat for Threatened Animal Species (number observed or previously recorded)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species observed or locally recorded (1 pt each)	0
State **Vulnerable** species observed or locally recorded (2.5 pt each)	0
State **Endangered** species observed or locally recorded (5 pt each)	0
Nationally **Vulnerable** species observed or locally recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species observed or locally recorded (20 pts each)	0
0 = 0 pts; <2 = 0.02 pts; 2 - <5 = 0.04 pts; 5 - <10 = 0.06 pts; 10 - <20 = 0.08pts; 20 or > = 0.1 pts	**0**
Score	0

CONSERVATION SIGNIFICANCE SCORE	**1**

Total Scores for the Site

	Score
LANDSCAPE CONTEXT SCORE	**1.14**
VEGETATION CONDITION SCORE	**33.86**
CONSERVATION SIGNIFICANCE SCORE	**1.00**

Vegetation Condition x Landscape Context x Conservation Significance =

UNIT BIODIVERSITY SCORE	38.60
Total Biodiversity Score (Biodiversity Score x hectares)	10.93

Photo Point and Vegetation Survey Location

Direction of the Photo

GPS Reference

Datum	GDA94
Zone (52, 53 or 54)	53
Easting (6 digits)	616702
Northing (7 digits)	6209706

Description

BAM site 4 was characterised by a dense cover (> 70%) of Triodia scariosa (Porcupine Grass)

What is the purpose of Assessment? Clearance | SEB Area | Other

Assessment for Clearance

Loss Factor	1.0
Loadings for clearance of protected areas	
Reductions for rehabilitation of impact site	
SEB Points required	**11.48**

Approximate hectares required	1.43
Economies of Scale Factor	0.5
Mean Annual rainfall for the site (mm)	305
Payment into the fund (GST Exclusive)	**$4,552.72**
Administration fee (GST Inclusive)	**$250.40**

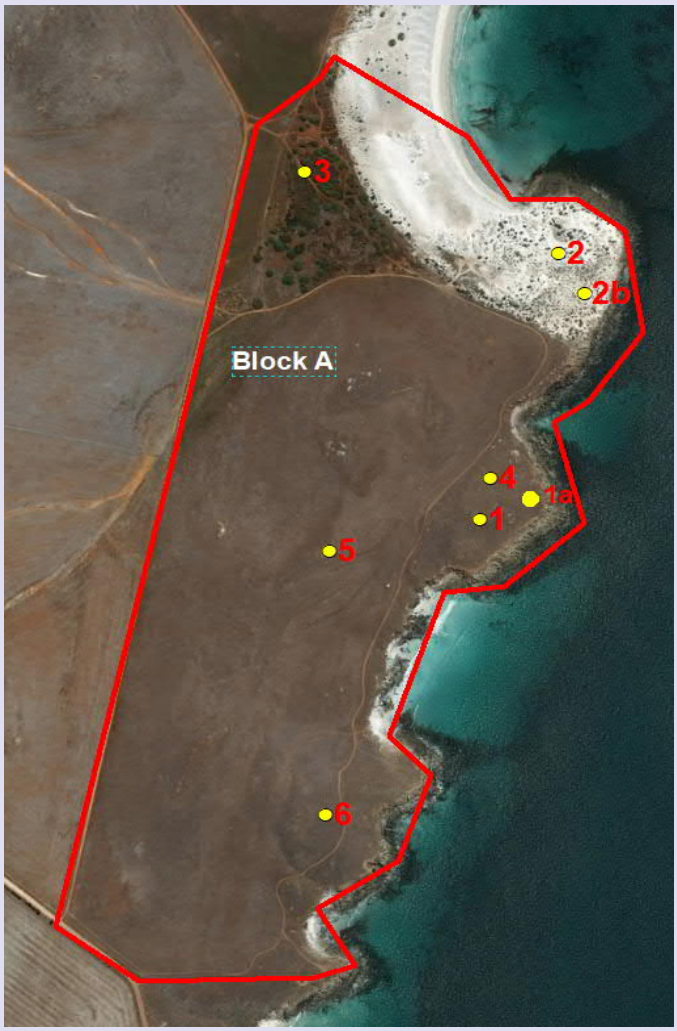
Bushland Assessment Scoresheets

(Version - 1 July 2019)

Block	A
Size of Block (Ha)	47.330
NRM Region	Eyre Peninsula
BCM Region	Eyre Peninsula
IBRA Association	Waretta

ASSESSOR(S)	Sonia Croft
DATE OF ASSESSMENT	29/08/2019

Map of the Block (Including the Sites)



Landscape Context Scores

Percent Vegetation Cover (5km radius) (%)	21
0-5% = 0 pts; >5-10% = 0.01 pts; >10-25% = 0.02 pts; >25-50% = 0.03 pts; >50-75% = 0.01 pt; >75-100% = 0 pts	
Score	0.02

% native veg. remaining in IBRA Assoc.	13
0-5% = 0.1 pts; >5-10% = 0.08 pts; >10-20% = 0.06 pts; >20-40%= 0.04 pts; >40-80%= 0.02 pt; >80% = 0 pts	
Score	0.06

% native veg. protected IBRA Assoc.	0
0-5% = 0.03 pts; >5-10% = 0.02 pts; >10-25% = 0.01 pt; >25% = 0	
Score	0.03

Block Shape Cleared perimeter:Area (km/km2)	
Cleared Perimeter (m) =	1600
Cleared Perimeter to area ratio	3.38
<6 = 0.03 pts; 6 to <12 = 0.02 pts; 12 to <18 = 0.01 pt	
Score	0.03

Wetland or Riparian Habitat present	
Riparian zone present (Yes/No) = 0.02 pt	No
Swamp/wetland present (Yes/No) = 0.03 pts	No
(Swamp/wetland may be +/- riparian zone)	
Score	0

Note; Blocks will score a minimum Landscape Context Score of 1

LANDSCAPE CONTEXT SCORE (max 1.25)	**1.14**

Plant Species Recorded (Native and Introduced)		Listed Species			Natives only		
Species	**Common Name**	**EPBC**	**SA**	**Not in quadrat**	**Regen**	**Annual Herbs** Spring survey	**Introduced Species**
Austrostipa sp.	Spear-grass						
Maireana brevifolia	Short-leaf Bluebush						
Nitraria billardierei	Nitre-bush						
Enchylaena tomentosa var.	Ruby Saltbush						
Lomandra effusa	Scented Mat-rush						
Triodia scariosa	Spinifex						
Salsola australis	Buckbush						
Asphodelus fistulosus	Onion Weed						*
Oxalis pes-caprae	Soursob						*
Lycium ferocissimum	African Boxthorn						*
Mesembryanthemum crystallinum	Common Iceplant						*
Hordeum glaucum	Blue Barley-grass						*
Lamarckia aurea	Toothbrush Grass						*
Brassica tournefortii	Wild Turnip						*
Galenia pubescens var. pubescens	Coastal Galenia						*

Threatened or Introduced Animal Species Recorded or Observed (Native and Introduced)		Threatened Species				Introduced Species
Species	Common Name	EPBC	SA	Past Record	Observed	

Vegetation Condition Scores

SITE:	BAM 5
BCM COMMUNITY	EP 3.1 Woodlands with Grassy or Low Sedge Understorey
VEGETATION ASSOCIATION DESCRIPTION	Asphodeulus fistulosus open herbland
SIZE OF SITE (Ha)	2.148274

Benchmarked attributes
(Scores determined by comparing to a Benchmark community)

Number of Native Species (Minus herbaceous annuals for spring Surveys)	7
Native Plant Species Diversity Score (max 30) from benchmark score *weighted by a factor of 2*	**8.0**
Number of regenerating native species	0
Regeneration Score (max 12) from benchmark community weighted by a factor of 1.5	**0**

Weed species (Top 5 Cover x Invasiveness)	Cover (max 6)	Weed Threat Rating (max 5)	C x I
Oxalis pes-caprae	5	3	15
Asphodelus fistulosus	3	2	6
Lycium ferocissimum	1	4	4
Lamarckia aurea	2	1	2
Hordeum sp.	1	1	1
	Cover x Threat		28
Weed Score (max 15) from benchmark community			**7**

Native Plant Life Forms	**Cover rating**
Trees > 15m	
Trees 5 - 15 m	
Trees < 5m	
Mallee > 5m	
Mallee < 5m	
Shrubs > 2m	
Shrubs 0.5 - 2m	1
Shrubs < 0.5	1
Forbs	
Mat Plants	
Grasses > 0.2m	
Grasses < 0.2m	1
Sedges > 1m	
Sedges < 1m	1
Hummock grasses	1
Vines, scramblers	
Mistletoe	
Ferns	
Grass-tree	
Total	5
Native Plant Life Forms (max 20) from benchmark score *weighted by a factor of 2*	**4.0**

Non-Benchmarked Attributes
(Scores determined from direct field observations)

Native:exotic Understorey biomass Score (max 5)	**0**

Is the community naturally treeless?	☐
Fallen Timber/Debris (max 5)	**0**
Hollow-bearing trees Score (max 5)	**0**
Mature Tree Score (max 8)	**0**
Tree Canopy Cover Score (max 5)	**0**

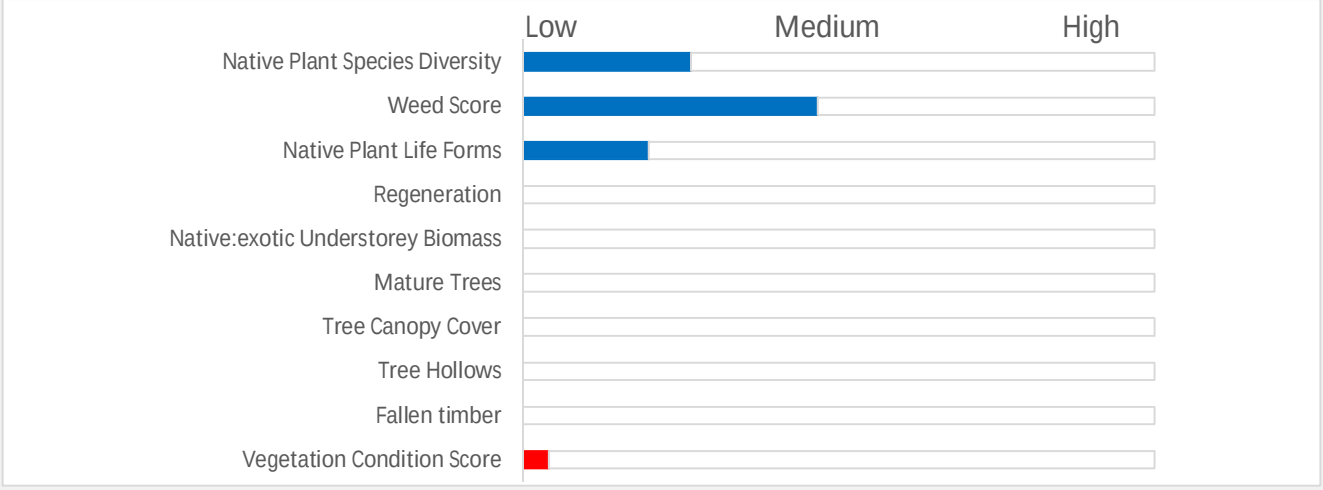
Vegetation Condition Score calculation

Positive Vegetation Attributes Score = Native species diversity + Regeneration + Native Plant Life Forms Fallen timber/debris + Hollow-bearing trees

- If the community Score is Not Benchmarked (SNB) for regeneration this score is multiplied 1.24

- If the community is naturally treeless this score is multiplied by 1.29

	12.00
Negative Vegetation Attributes Score = (15 - Weeds) + ((10 - Biomass score - Tree Canopy Cover Score)exp2/2)	58.00
VEGETATION CONDITION SCORE (Positive veg attributes x ((80 - Negative vegetation attributes) / 80))	**3.30**



Conservation Significance Score

Is the vegetation association considered a Threatened Ecological community or Ecosystem?	Yes/No
State (Provisional List of Threatened Ecosystems of SA) **Rare** community (0.1 pt)	☐
State (Provisional List of Threatened Ecosystems of SA) **Vulnerable** community (0.2 pts)	☐
State (Provisional List of Threatened Ecosystems of SA) **Endangered** community (0.3 pts)	☐
Nationally (EPBC Act) V**ulnerable** community (0.35 pts)	☐
Nationally (EPBC Act) **Endangered** or **Critically Endangered** community (0.4 pts)	☐
Note; all sites will score a minimum Conservation Significance Score of 1 **Score**	1

Number of Threatened Plant Species recorded for the site (within the site)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species recorded (1 pt each)	0
State **Vulnerable** species recorded (2.5 pt each)	0
State **Endangered** recorded (5 pts each)	0
Nationally **Vulnerable** species recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species recorded (20 pts each)	0
0 = 0 pts; <2 = 0.04 pts; 2 - <5 = 0.08 pts; 5 - <10 = 0.12 pts; 10 - <20 = 0.16 pts; 20 or > = 0.2 pts	**0**
Score	0

Potential habitat for Threatened Animal Species (number observed or previously recorded)	Number
**If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.*	
State **Rare** species observed or locally recorded (1 pt each)	0
State **Vulnerable** species observed or locally recorded (2.5 pt each)	0
State **Endangered** species observed or locally recorded (5 pt each)	0
Nationally **Vulnerable** species observed or locally recorded (10 pts each)	0
Nationally **Endangered** or **Critically endangered** species observed or locally recorded (20 pts each)	0
0 = 0 pts; <2 = 0.02 pts; 2 - <5 = 0.04 pts; 5 - <10 = 0.06 pts; 10 - <20 = 0.08pts; 20 or > = 0.1 pts	**0**
Score	0
CONSERVATION SIGNIFICANCE SCORE	**1**

Total Scores for the Site

	Score
LANDSCAPE CONTEXT SCORE	**1.14**
VEGETATION CONDITION SCORE	**3.30**
CONSERVATION SIGNIFICANCE SCORE	**1.00**

Vegetation Condition x Landscape Context x Conservation Significance =	
UNIT BIODIVERSITY SCORE	3.76
Total Biodiversity Score (Biodiversity Score x hectares)	8.08

Photo Point and Vegetation Survey Location

Direction of the Photo

GPS Reference

Datum	GDA94
Zone (52, 53 or 54)	53
Easting (6 digits)	616440
Northing (7 digits)	6209596

Description

Rocky ridge dominated by exotics, but also with very sparse native regrowth (<1% cover)

What is the purpose of Assessment? Clearance | SEB Area | Other

Assessment for Clearance

Loss Factor	1.0
Loadings for clearance of protected areas	
Reductions for rehabilitation of impact site	
SEB Points required	**8.49**

Approximate hectares required	1.06
Economies of Scale Factor	0.5
Mean Annual rainfall for the site (mm)	305
Payment into the fund (GST Exclusive)	**$3,365.47**
Administration fee (GST Inclusive)	**$185.10**

Appendix D. Coastal Modelling Report

Port Spencer Sediment Transport Modelling Investigation

Prepared for:

PENINSULA | PORTS

eCoast
eTakutai

MOHIO - AUAHA - TAUTOKO
UNDERSTAND - INNOVATE - SUSTAIN

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Port Spencer Sediment Transport Modelling Investigation

Report Status

Version	Date	Status	Approved by
V1	1 Oct 2019	Draft	STM
V2	7 Oct 2019	Draft	STM
V3	9 Oct 2019	Draft	STM
V4	15 Oct 2019	Final	STM

It is the responsibility of the reader to verify the version number of this report.

Authors

Dougal Greer *MSc*

Sam O'Neill *MSc*

Executive Summary

This report presents the results of a modelling investigation into the wave, hydrodynamic and sediment transport regime of the marine environment directly offshore from Port Spencer located in Spencer Gulf in South Australia. This is being undertaken for Free Eyre to understand the effects of a proposed grain export terminal at this location. The development includes a causeway, a wharf and a vessel which is located in the berth for approximately 60 days per year (for 3 days at a time).

The deliverables of this project are:

1) Literature and data review/delivery
2) Wave modelling
3) Hydrodynamic modelling
4) Sediment transport assessment

A series of models were developed to simulate the wave climate, the coupled hydrodynamic and wave flow regime and the sediment transport regime. Where data was available, these models were calibrated against measured data. The project extensively used the data collected as part of a pervious study in the area by ASR Ltd (Grant et al, 2011).

The wave model calibrated well against measured data although it tended to slightly underestimate peaks in wave height. The hydrodynamic model calibrated well against sea level and current data although it sometimes underestimated peak current velocities.

The sediment transport model simulated a period of 13 days in winter and summer and was used to simulate the coastline as is as well as with the proposed causeway in place and with the causeway and loading vessel in place. The results were scaled up to estimate annual changes in sediment transport due to the proposed development.

Sediment with a grain size of 0.13 mm is more mobile than sediment with a grain size of 0.3 mm and so can be considered the worst, or most conservative, case. Annual sedimentation was calculated by averaging the winter and summer annual changes in accretion and erosion due to the presence of the proposed development. Greater accretion in the nearshore on the reefs should be treated with caution as sediment is unlikely to settle on the rocky substrate. The results indicate broad post-development accretion to the south of the development between 0.01 m/annum and 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.04 m/annum (2 m in 50 years) in localised areas. Broad post-development erosion to the north of the structure is predicted to be between 0.01 m/annum to 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.03 m/annum (1.5 m in 50 years) in places. The pocket beach to the south shows predicted post-development accretion of between 0.01 m/annum and 0.04 m/annum in places. Rogers Beach to the north shows a small increase in post-development erosion of up to 0.005

m/annum. The seabed extent affected by ranges of accretion and erosion rates are presented in the following table:

Area affected by the development in terms of change to annual accretion and erosion rates.

Type	Range of Accretion/Erosion change (m/annum)	Area Affected Lower Limit (km^2)	Area Affected Upper Limit (km^2)
Accretion	0.005 to 0.01	0.0845	0.1673
Accretion	0.01 to 0.02	0.0109	0.1199
Accretion	0.02 to 0.03	0.0000	0.0324
Accretion	0.03 to 0.04	0.0000	0.0039
Erosion	-0.005 to -0.01	0.0004	0.2014
Erosion	-0.01 to -0.02	0.0000	0.0786
Erosion	-0.02 to -0.03	0.0000	0.0248
Erosion	-0.03 to -0.04	0.0000	0.0002

The changes in hydrodynamics, waves and consequently the sediment transport regime, decrease with distance from the development and are expected to be negligible around Lipson Cove and Lipson Island. Additionally, Lipson cove is south of the development in a northward moving sediment transport regime, as demonstrated by the numerical modelling and the presence and orientation of zeta beaches all along this coast.

An equilibrium in accretion/erosion will be reached at some point though being chronic this is likely over a larger number of years. ‘Chronic’ here indicates persistence over time rather than being indicative of severe impacts. However, it is unlikely that a steady state will result until or unless the accretion on the southern side progresses to a stage where it is bypassing the solid/nearshore part of the causeway. If this was left to occur, there would be consequent erosion of Rogers beach to the north. Therefore, annual monitoring with potential sand transfer from the southern to the northern side of the structure is recommended to ensure the coastal environment is protected noting that in this relatively benign environment, sand transfer is likely to be required infrequently.

Monitoring locations should be defined on the northern side of the proposed structure and the southern end of the beach to the north (some 500 m). Trigger levels for remediation actions should be defined in line with acceptable levels of shoreline erosion or ecological considerations. It is important to note that sediment transport rates are relatively low at this site, which means sand transfer to mimic the current sediment transport regime once the structure has been built will be relatively infrequent.

Contents

Figures

Tables

1 Introduction

1.1 Background

This report presents the result of a modelling investigation into the wave, hydrodynamic and sediment transport regimes of the marine environment directly offshore from Port Spencer, located in Spencer Gulf in South Australia (Figure 1.1). This is being undertaken for Free Eyre to understand the effects of a proposed grain export terminal at this location. The proposed development is shown in Figure 1.2. The development includes a causeway, a wharf and a vessel which is located in the berth for approximately 60 days per year (for 3 days at a time).

The deliverables of this project are:

1) Literature and data review/delivery
2) Wave modelling
3) Hydrodynamic modelling
4) Sediment transport assessment

A previous study was undertaken by ASR Ltd (Grant *et al*, 2011) exploring the effects of a previously proposed structure at the same location as the current proposed grain export terminal. eCoast have access the data collected as part of this study which have been used extensively in this study.

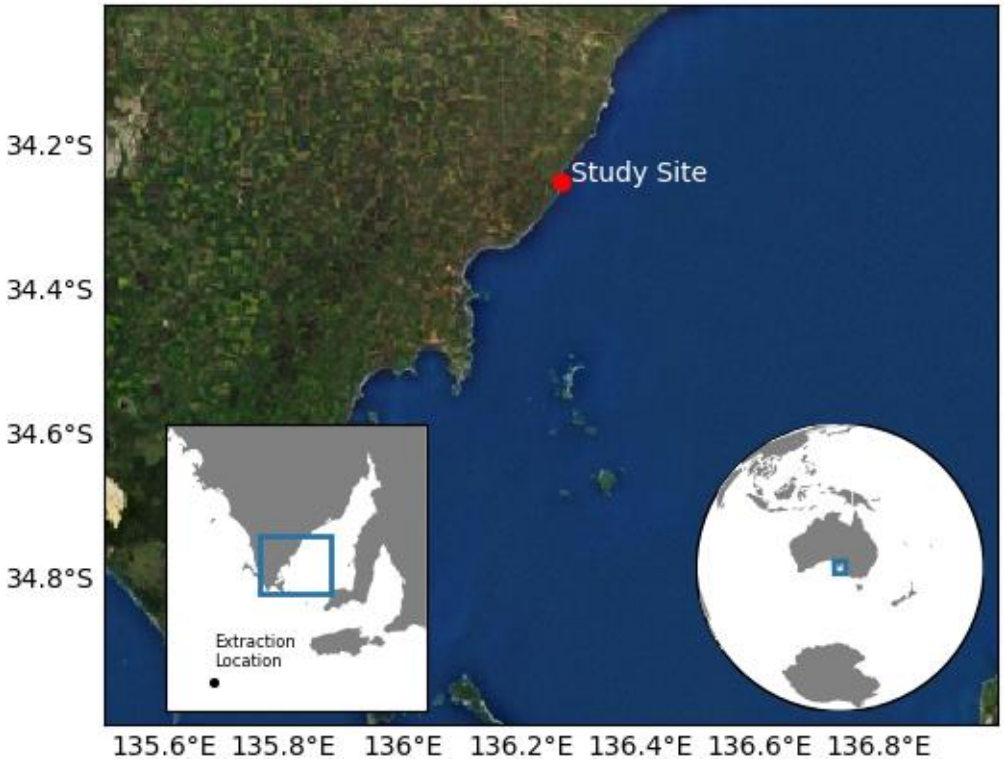

Figure 1.1. The location of the Study Site.

Figure 1.2: The layout of the proposed development with causeway (brown/yellow), the wharf (magenta) and the outline of the berthed ship (red).

1.2 Site Overview

Port Spencer is located on the west coast of Spencer Gulf. The coastline is aligned approximately SW to NE and features numerous sandy embayments interspersed with rocky headlands. The wave climate at this location is a mix of smaller long period swell that penetrates the gulf from the Southern Ocean and locally-generated wind waves. The tidal range on spring tides is approximately 2 m and neap tides can result in alomost slack water for 2-3 days (dodge tides) if they coincide with a period of weak winds.

The physical oceanography of Spencer Gulf consists of warm, saline waters during summer which are prevented from mixing with offshore waters by a front at the mouth of the Gulf.

During the remaining time periods the cold, dense plumes of water flow from the Gulf out onto the shelf. (Gillanders *et al*., 2013).

A 28 year offshore record of wind and wave statistics was extracted from -36.5º, 134.5º (See Figure 1.1) from a 0.5 degree by 0.5 degree global model of wind and wave characteristics[1] maintained by NOAA (National Oceanic and Atmospheric Administration). This record was analysed to provide an overview of the monthly variability in the offshore wind and wave climate (Figure 1.3 and Figure 1.4). The wind record shows a strong seasonal pattern with dominant SE (onshore) winds between January and March, NE (offshore) winds between June and October and transition periods from April to May and November to December. The wave direction is almost exclusively from the SW with the largest waves occurring between June and September. From this record, it is expected that the study site will experience more long period swell but reduced locally generated wind waves in winter, and conversely more wind swell but reduced long period swell in summer.

[1] http://polar.ncep.noaa.gov/waves/wavewatch/

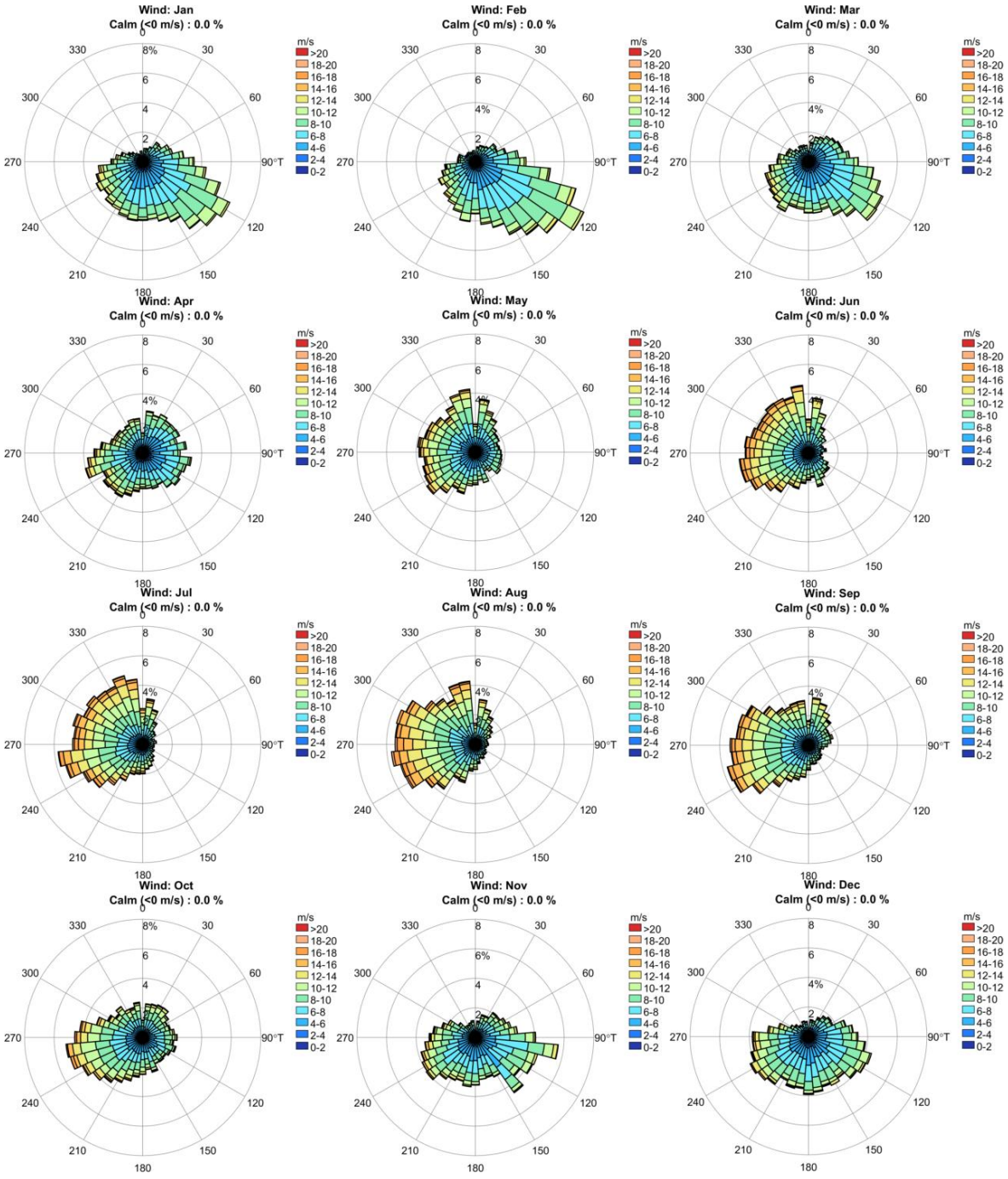

Figure 1.3. Monthly offshore wind speed and direction. Note wind directions are expressed using a ‘direction from’ convention.

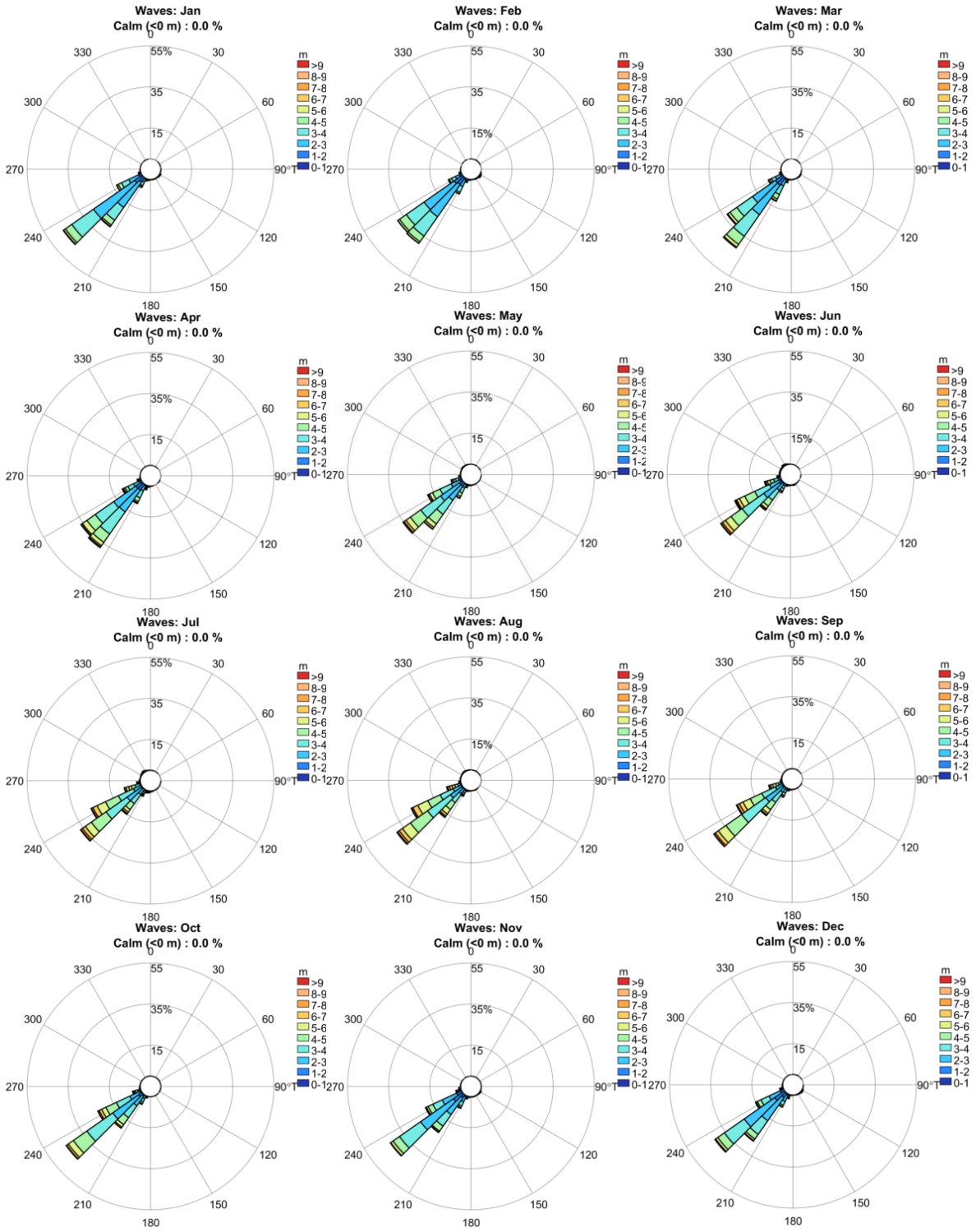

Figure 1.4. Monthly offshore significant wave height and peak direction. Note wave directions are expressed using a ‘direction from’ convention.

2 Local Data Sources and Literature Review

Many previous studies have been undertaken to understand the physical marine environment in Spencer Gulf and a good summary of these studies can be found in Richardson *et al*. (2005). They describe the well documented (Nunes and Lennon, 1987; Fuller *et al*., 1994) clockwise water circulation pattern known as the Port Lincoln Boundary Current (PLBC) which flows into the gulf along the west coast of the gulf deflecting eastwards due to the Coriolis effect.

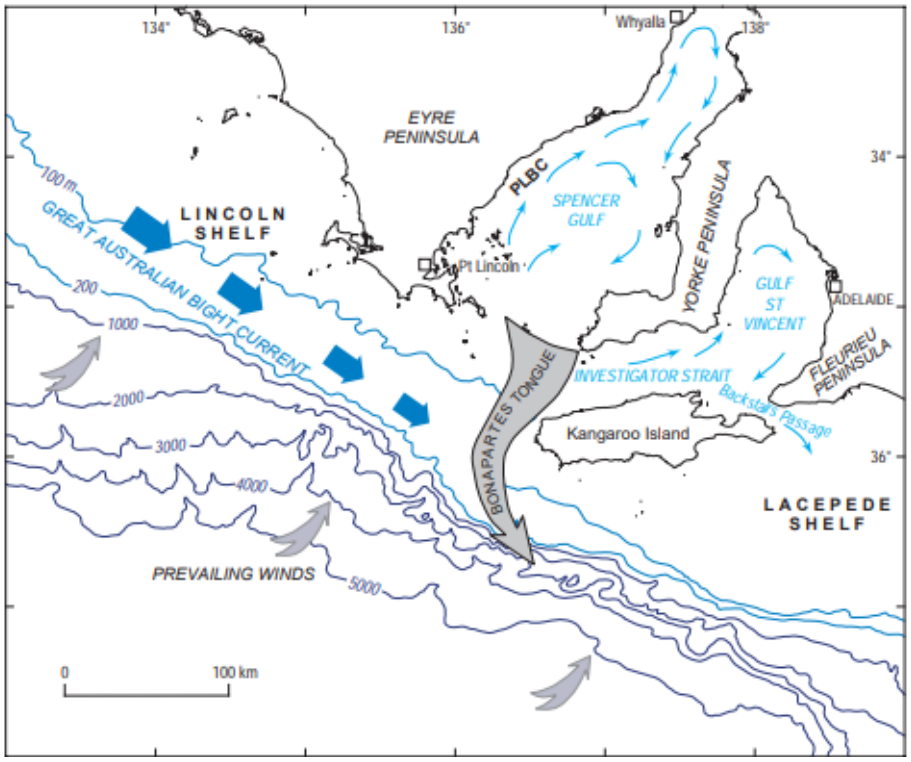

Figure 2.1: Diagram showing oceanography of the Spencer and St. Vincent Gulfs region, highlighting the clockwise water circulation pattern in each gulf (source: Richardson et al, 2005)

A wave modelling study was undertaken by Doubell *et al*. (2015) which was calibrated at the entrance and the upper head of the Gulf. The wave height data recorded near the entrance (Z1 in Figure 2.2) was digitised for this project and used for the purposes of calibrating our wave model.

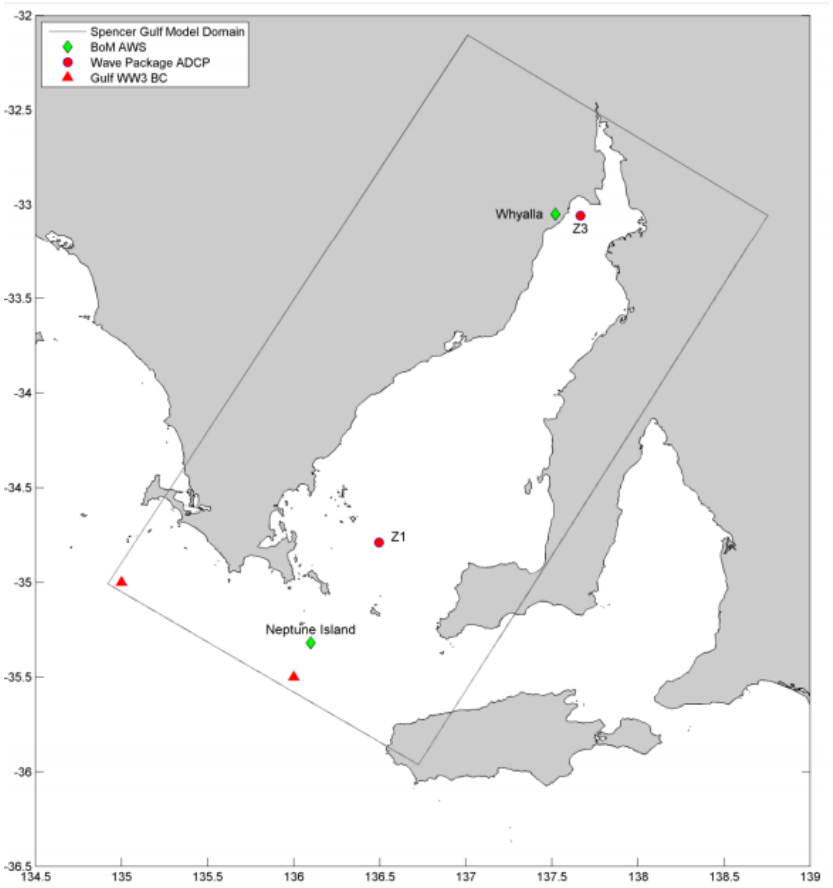

Figure 2.2: Location of the Z1 buoy location in Doubell *et al.* (2015).

This study has made considerable use of the data presented in (Grant *et al.*, 2011), which was a sediment transport study based in the same location. This project included a field work component which provided:

- Sea level, and current data from an ADCP deployment.
- Sediment grain size analysis from the same area
- Salinity and temperature data (not used in this study)

The ADCP was deployed in approximately 17.5 m (LAT) at -34.249910°, 136.271970° (Figure 2.3). Data was collected over 5 deployments from 14 October 2009 to 17 September 2010. Though there are gaps in the record, it provides a comprehensive amount of wave and current data for use in model calibration presented throughout this report.

Figure 2.3: Location of the ADCP deployment in Grant *et al*. (2011)

Sediment grain size analysis of 18 samples (Figure 2.4) is presented in Grant *et al*. (2011), originally sourced from Golder Associates, (2010), and which provides the following summary:

> *Along the length of the berthing wharf*[2] *a layer of medium to fine grained sediments occur. 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 shore. Either side of 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 wharf mean sediment grain size increases to 0.30 mm, suggesting sorting of sediments due to wave mechanism*

[2] this refers to a previous berthing design which is different in layout to the current proposed design, but which is in the same locations

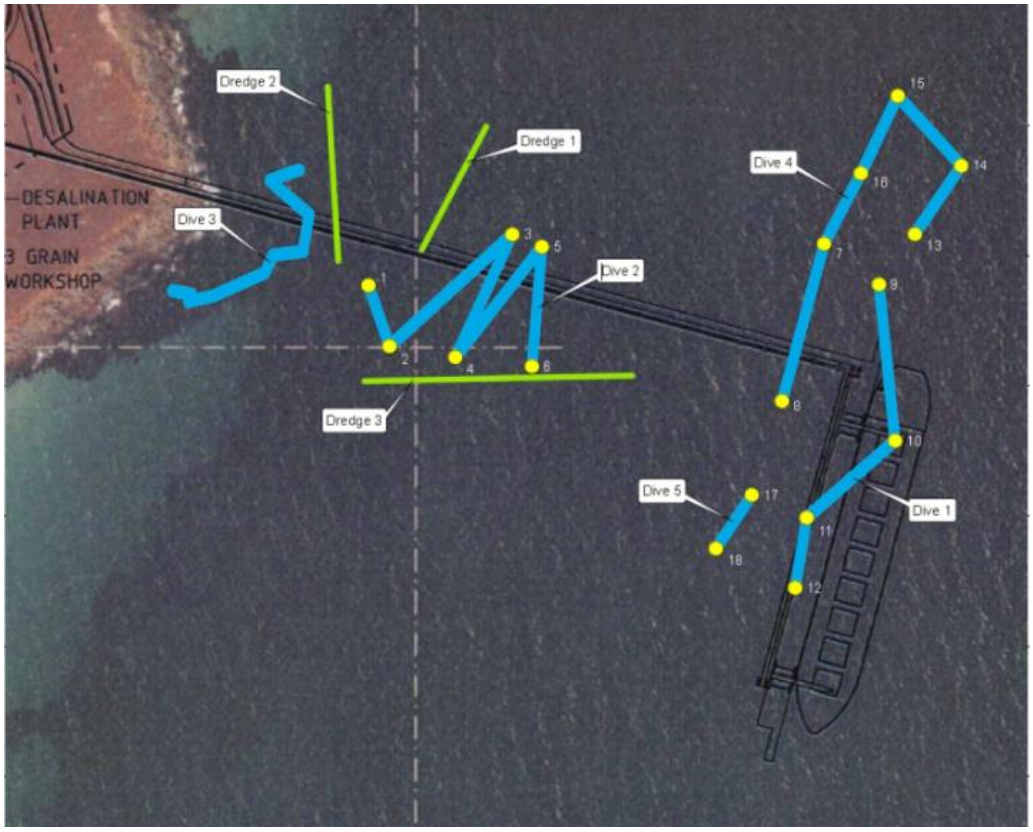

Figure 2.4: The locations of the sediment samples analysed in Golder Associates, (2010)

3 Modelling Methodology

Models were developed for waves, hydrodynamics and sediment transport. In each case, the study site was modelled under three scenarios:

- as is (baseline condition)
- with the causeway included
- with the causeway included and with the berthed ship in place.

The pilings of the proposed wharf were not included in the models as they are only ~1m in diameter and are not expected to have a significant impact on the broader sediment transport regime. Comparing the model results with and without the development in place provides the means to understand the changes to the marine physical environment due to the development.

In this section the model setup, parameterisation and calibration are presented.

3.1 Bathymetry

Bathymetry data were sourced from GEBCO (Becker *et al*. 2009), digitised from hydrographic charts and two bathymetric surveys were provided by the client (Figure 3.1 and Figure 3.2) which provided coverage of the study site.

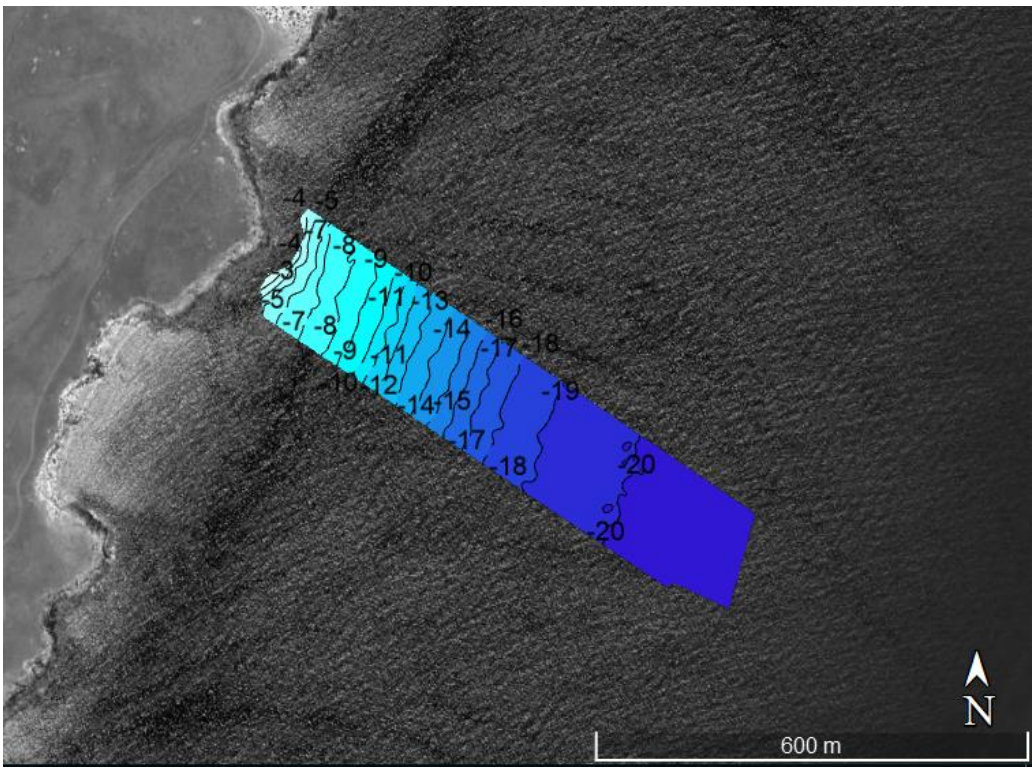

Figure 3.1: Nearshore bathymetric data provided by the client.

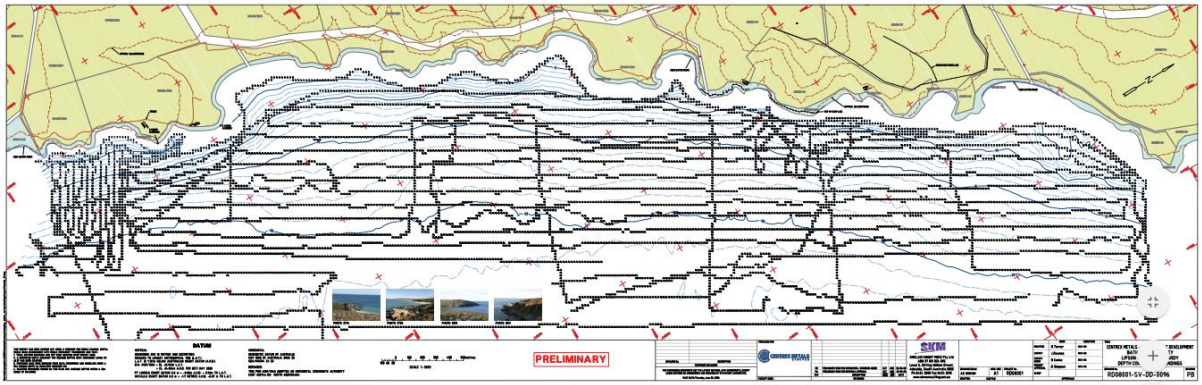

Figure 3.2: Broadscale bathymetric coverage provided by the client.

Model bathymetries were gridded using Kriging interpolation in SURFER® software. Kriging is a geostatistical gridding method that has proven useful and popular in many fields. This method produces visually appealing contour and surface plots from irregularly spaced data. Kriging attempts to express trends that are suggested in your data, so that, for example, high points might be connected along a ridge, rather than isolated by bull's-eye type contours. Kriging always uses the measured value exactly (known as an “exact” interpolator) when it coincides with the grid node in the gridded data file. Survey track lines were mostly perpendicular to seabed gradients, as a result seabed features are well represented in the bathymetry. Therefore, Kriging interpolation is the best possible method to accurately represent the data.

3.2 Wave Modelling

Wave hindcasting was undertaken using the wave model SWAN (Simulating WAves Nearshore) which is part of the Delft3D model suite. SWAN is a third-generation ocean wave propagation model, incorporating current knowledge regarding the generation, propagation and transformation of wave fields in both deep water and nearshore regions. SWAN solves the spectral action density balance equation for frequency-directional spectra. This means that the growth, refraction, and decay of each component of the complete sea state, each with a specific frequency and direction, is solved, giving a complete and realistic description of the wave field as it changes in time and space.

Physical processes that are simulated include the generation of waves by the surface wind stress, dissipation by white-capping, resonant nonlinear interaction between the wave components, bottom friction and depth limited breaking. The model is described fully in the user manual (Holthuijsen *et al*., 2004).

The model was developed using a series of four nested domains with sequentially higher resolution with proximity to the study site. The bathymetry grids are shown in Figure 3.3. The highest resolution model grid had a resolution of approximately 9 m by 9 m.

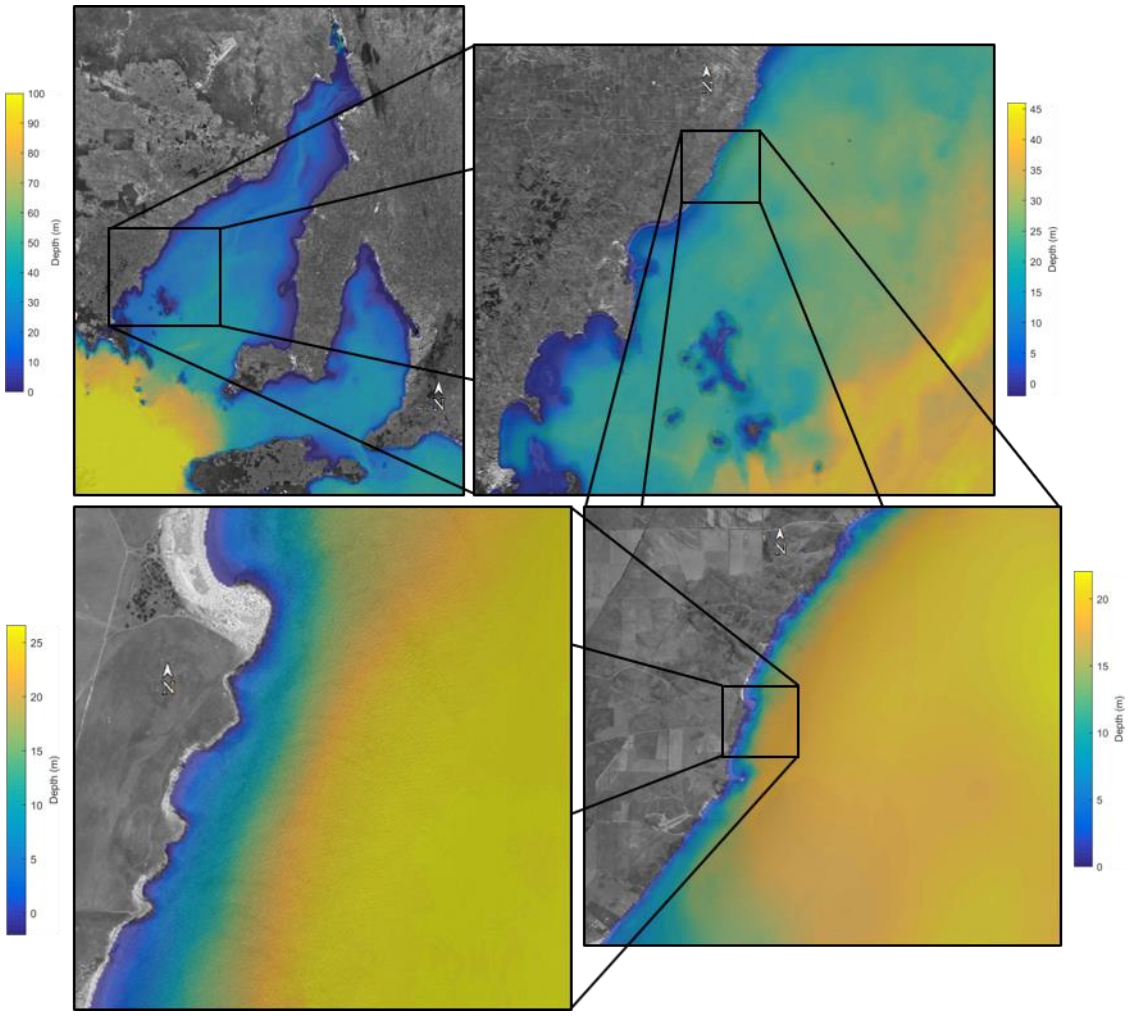

Figure 3.3: Nested bathymetry grids used for the Swan wave model.

Spectral wave boundary conditions were applied to the open boundaries of the largest model grid. The data source was the hind-casted, 2-dimensional wave spectra from the European Centre for Medium-Range Weather Forecasts' (ECMWF) ERA 5 0.25°x0.25° (approximately 27.5 km by 27.5 km) resolution database (Berrisford *et al*., 2011). The wave model is based on the WAM approach (Komen *et al.*, 1994). The spectral data has 24 directions and 30 frequencies from 0.0345 to 0.5473 Hz. Data are available every six hours between 1979 and present.

Spatially and temporally varying wind boundary conditions were derived from the National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) dataset. This provided hourly wind data on a grid with a resolution of 0.312 by 0.312 degrees

from 1979 until 2011 and 0.205 by 0.204 from 2011 onwards. Wind data was also sourced from the Australian Bureau of Meteorology (BoM) from the Port Lincon and Neptune Island Automatic Weather Stations (AWSs).

The wave model was run for the period of the ADCP deployment period (14 October 2009 to 17 September 2010) for the purposes of calibration and then for an additional year. The simulation years was chosen by comparing wave roses of offshore wave height peak period and wind speed for 1979 to 2018 with the same rose plots for each individual year. Assessment of these plots showed 2001 to be the year that best resembled the long term record (Figure 3.6) and this was chosen as the simulation year for the wave model.

The wave model wave calibrated against the data presented in (Grant *et al*., 2011) and wave height data digitised from Doubell *et al*. (2015).

The calibration of the wave model against significant wave height was good at the Z1 location capturing the main variability in wave energy (Figure 3.4). The calibration was more challenging at the study site (Figure 3.5) due to an absence of a reliable source of local wind data at that location. The calibration process explored the use of AWS wind data and scaling of wind fields, but finally the NCEP wind field proved most effective for model calibration. At the ADCP deployment location the model largely reproduced the Hs but tended overestimated the baseline amount of wave energy and underestimated some of the larger peaks. This may be due to an underestimation of wave energy by the wave boundary conditions (Figure 3.4). Nonetheless, the broad pattern of wave height was well represented by the model. The measured peak wave period is bimodal and oscillates between long (~ 12 s) and short (~ 4 s) periods. While the model did not show the same degree of variability in period the bimodal pattern was reproduced well.

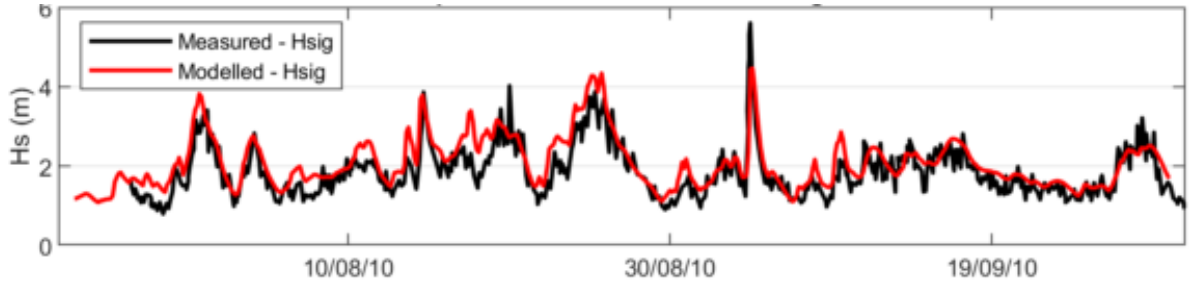

Figure 3.4: Comparison between significant wave height measured by the ADCP (Doubell *et al*., 2015) and the SWAN wave model.

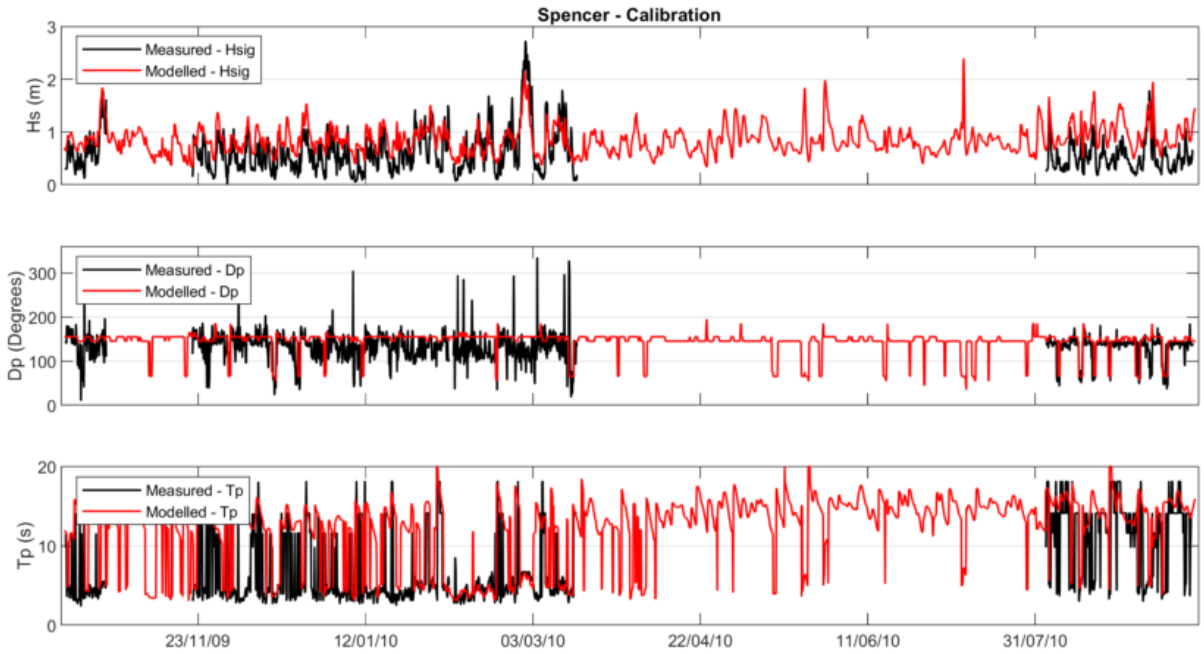

Figure 3.5: Comparison between waves measured by the ADCP (Grant *et al*., 2011) and the SWAN wave model.

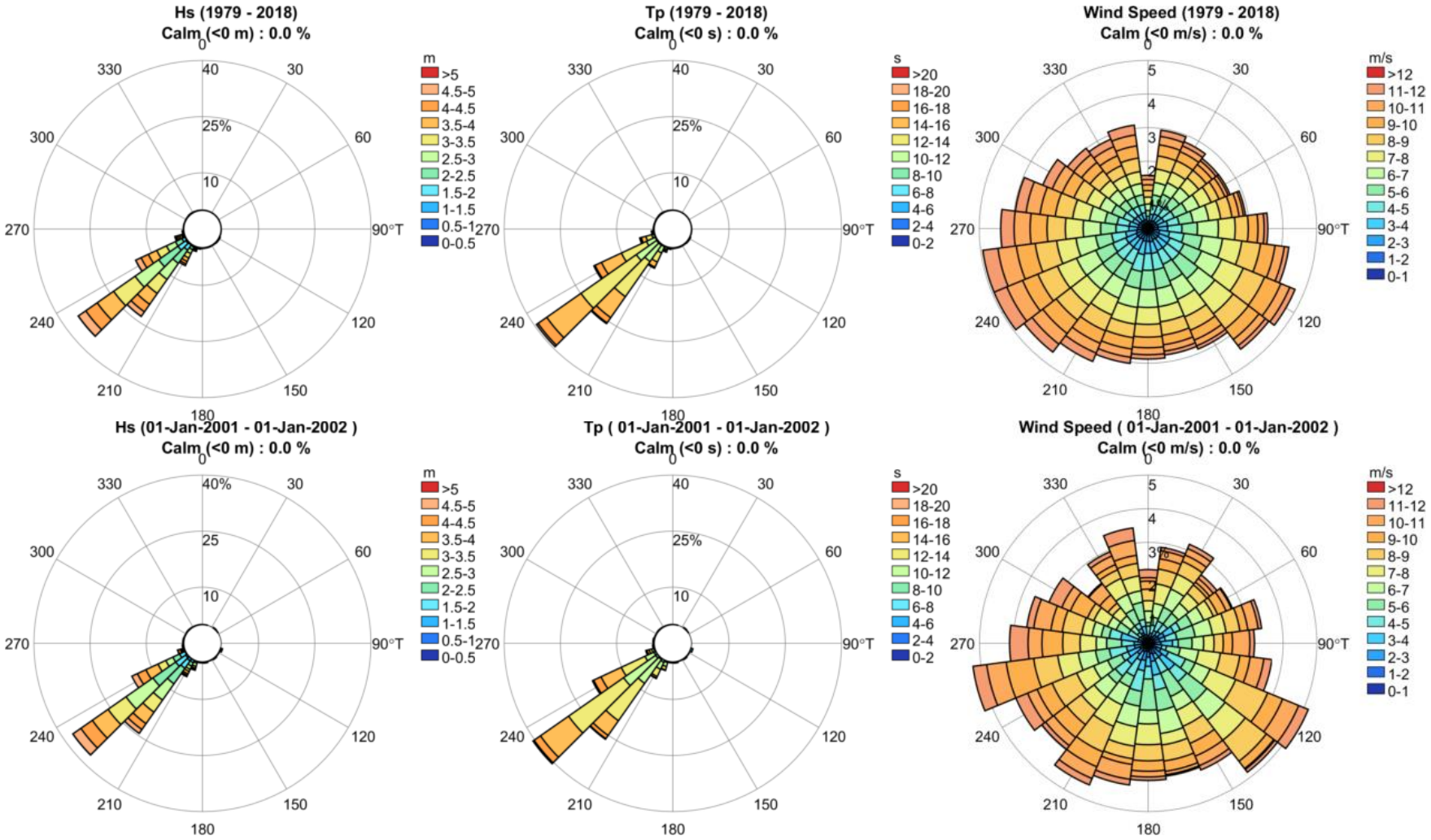

Figure 3.6: Rose plots of significant wave height (left) peak period (centre) and wind speed (right) for the period of 1979 to 2018 (top) and for 2001 (bottom).

3.3 Hydrodynamic Modelling

To model hydrodynamics and sediment transport we used Delft-Flow coupled with Delft-Wave (which is a front end for SWAN) modules from the Delft3D Model Suite from Deltares, which is an industry standard for hydrodynamic numerical modelling.

The modelling setup used a system of nested model grids using a nesting process known as Domain Decomposition (DD). Standard nesting procedures use a coarse model run over a large model domain, and nested boundary conditions are extracted from this to run higher resolution models covering a smaller area contained within the domain of the coarse grid. DD is a dynamically coupled nesting system whereby the coarser and finer grids are run simultaneously, and information is passed between the domains (Deltares, 2013). Unlike standard nesting, the use of DD means that information pertaining to hydrodynamic processes is not lost between domains in the nesting process.

For this model four nested model bathymetries were used to provide increased resolution at the study site. The highest resolution grid had a grid spacing of approximately 12 m by 12 m. The bathymetric grids are shown in Figure 3.7.

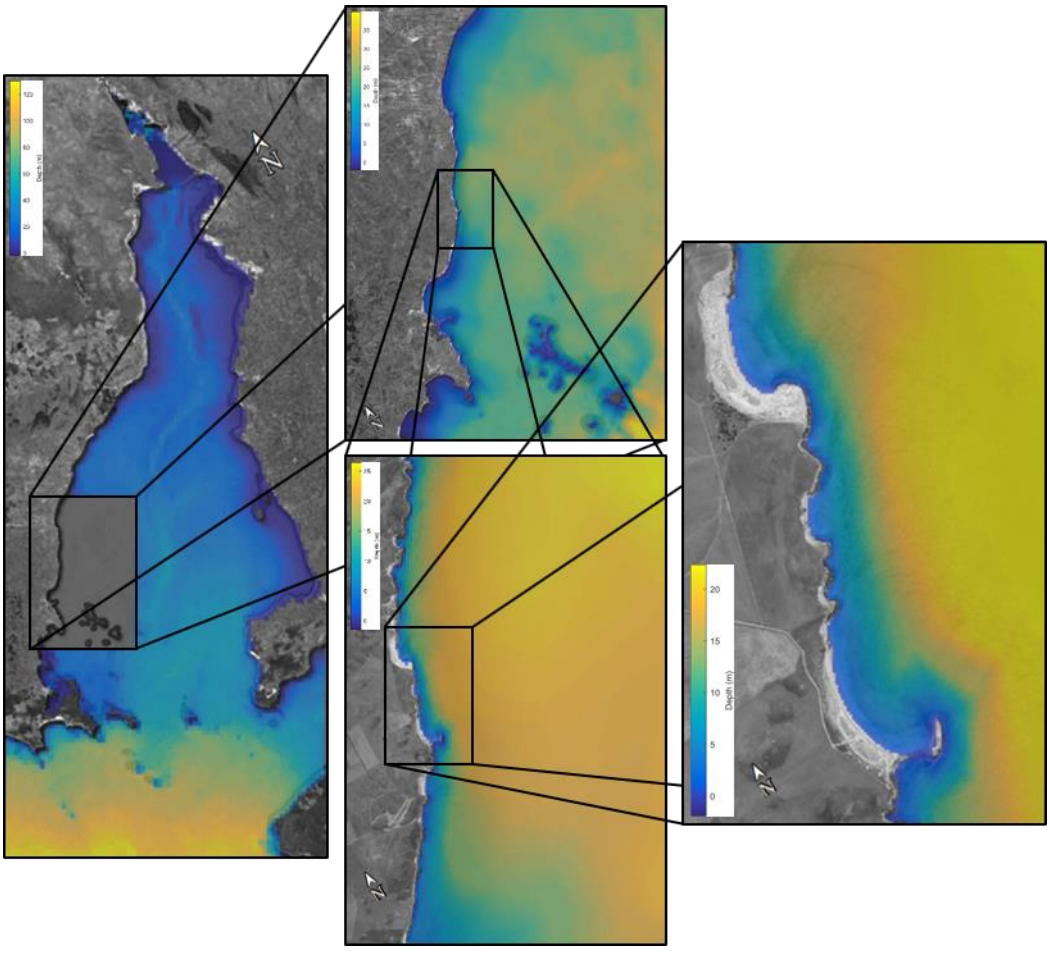

Figure 3.7: Nested bathymetry grids used for the Delft3D coupled hydrodynamic and wave model wave model.

The hydrodynamic model was run as a 2D depth-averaged model and included the effects of tides, wind, atmospheric pressure and waves. Salinity and temperature were excluded from the model as they are unlikely to have a strong impact on local circulation patterns.

Sea level variability was represented in the model using tidal boundary conditions. Tidal timeseries were extracted from the TPXO wave atlas (Egbert and Erofeeva, 2002). This model was developed by the Oregon State University, who created a global model of ocean tides which uses along track averaged altimeter data from the TOPEX/Poseidon and Jason satellites since 2002. The methodology applied in the global tide models has been refined to create regional models at higher resolution. For this project, we used the Pacific Ocean model with a resolution of 1/12 degree. The model provided the 11 most influential constituents, as well as two long period (Mf, Mm) harmonic constituents.

Wind and wave parameterisation was the same as that used in the longer term wave model (Section 3.2). Spatially varying atmospheric pressure was taken from NCEP source but is available on a 0.5 by 0.5 degree resolution grid.

The model was run for a portion of the ADCP deployment period (15 Oct 2009 to 17 March 2010) for the purposes of model calibration. Additional 1 month simulations were run for February (Summer) and August (Winter) of the chosen representative year of 2001.

The model was calibrated against the ADCP data by comparing modelled versus measured sea level (Figure 3.8) and current speed and direction (Figure 3.9 to Figure 3.11). The model predicted the sea level well accounting for spring and neap variability as well as reproducing the long term trend in sea level variability. The model reproduced the spring and neap current variability well although it tended to underestimate some of the peak current speeds at the ADCP deployment location. Current direction was well reproduced by the model overall. The highest resolution model nest used a Chezy friction of 70 $m^{1/2}/s$ and horizontal eddy viscosity of 2 $m^2 s^{-1}$.

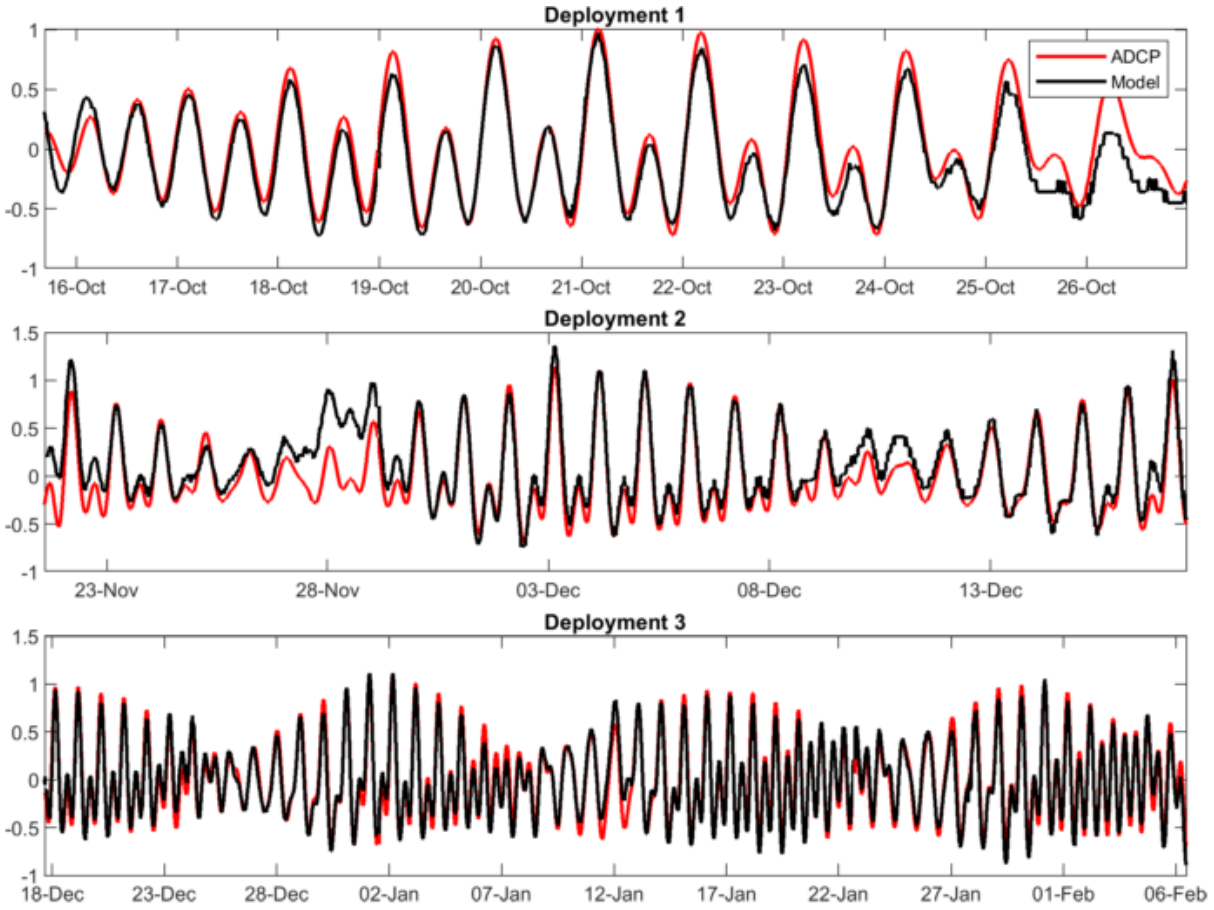

Figure 3.8: Comparison between sea level measured by the ADCP over 5 deployments (Grant *et al*., 2011) and the coupled hydrodynamic and wave Delft3D model.

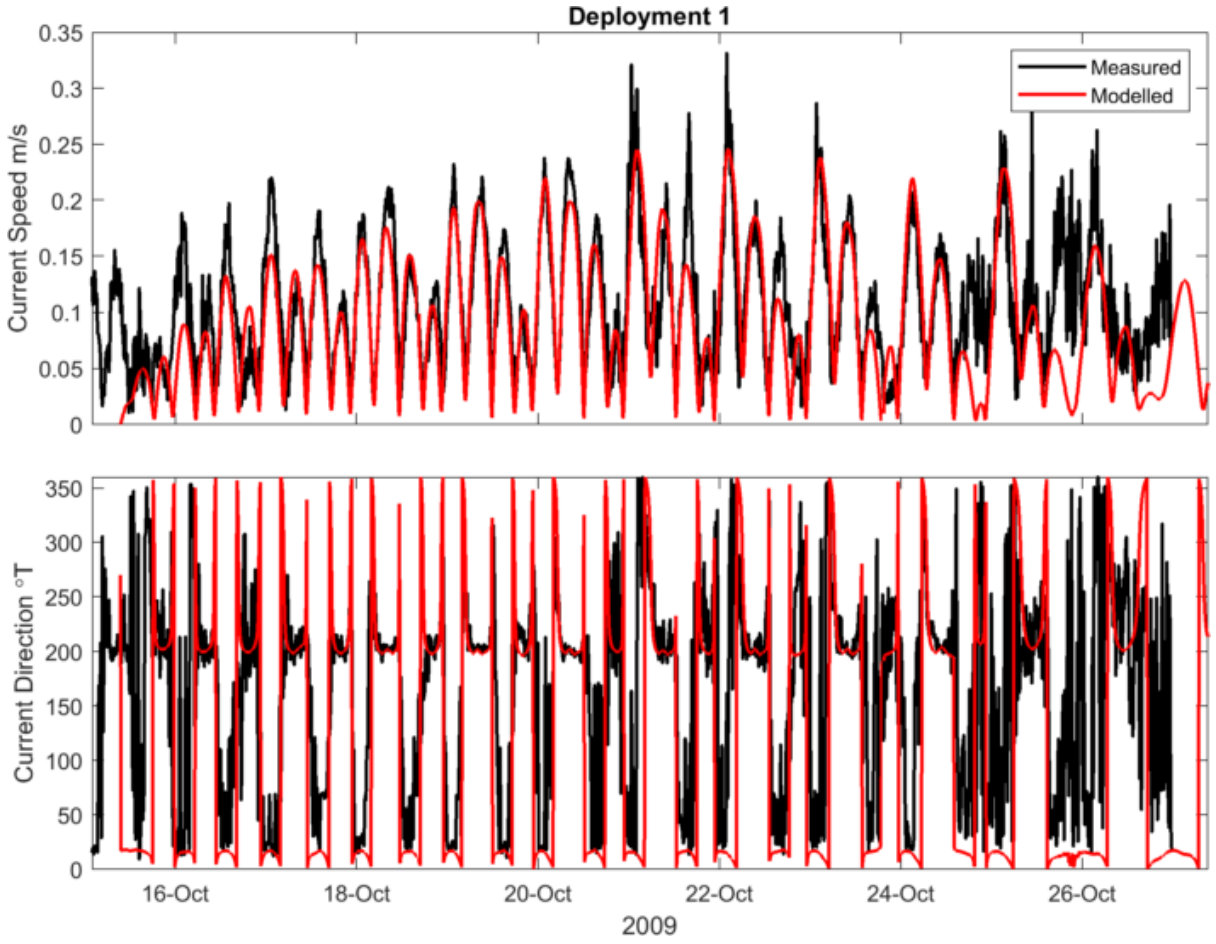

Figure 3.9: Comparison between current speed and direction measured by the ADCP during deployment 1 (Grant *et al*., 2011) and the coupled hydrodynamic and wave Delft3D model.

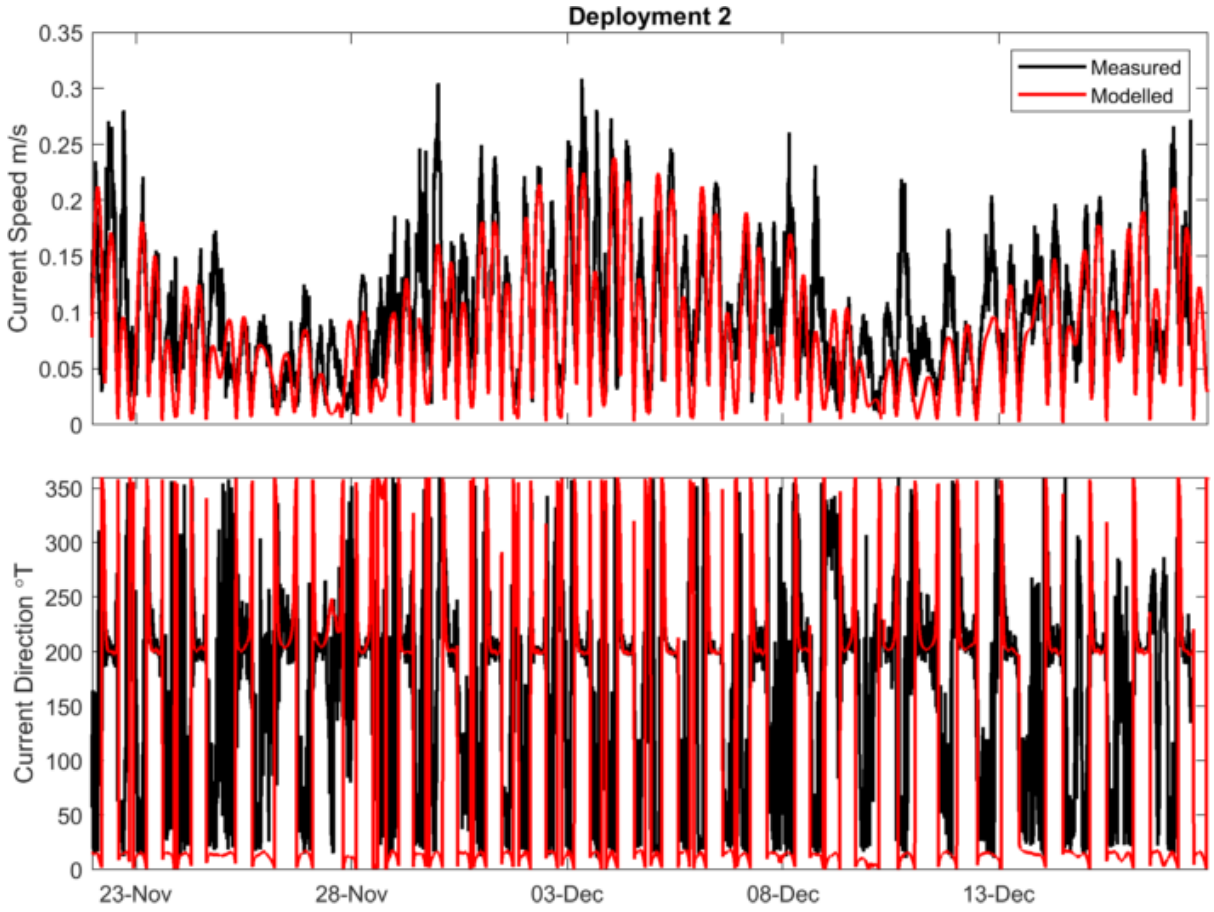

Figure 3.10: Comparison between current speed and direction measured by the ADCP during deployment 2 (Grant *et al*., 2011) and the coupled hydrodynamic and wave Delft3D model.

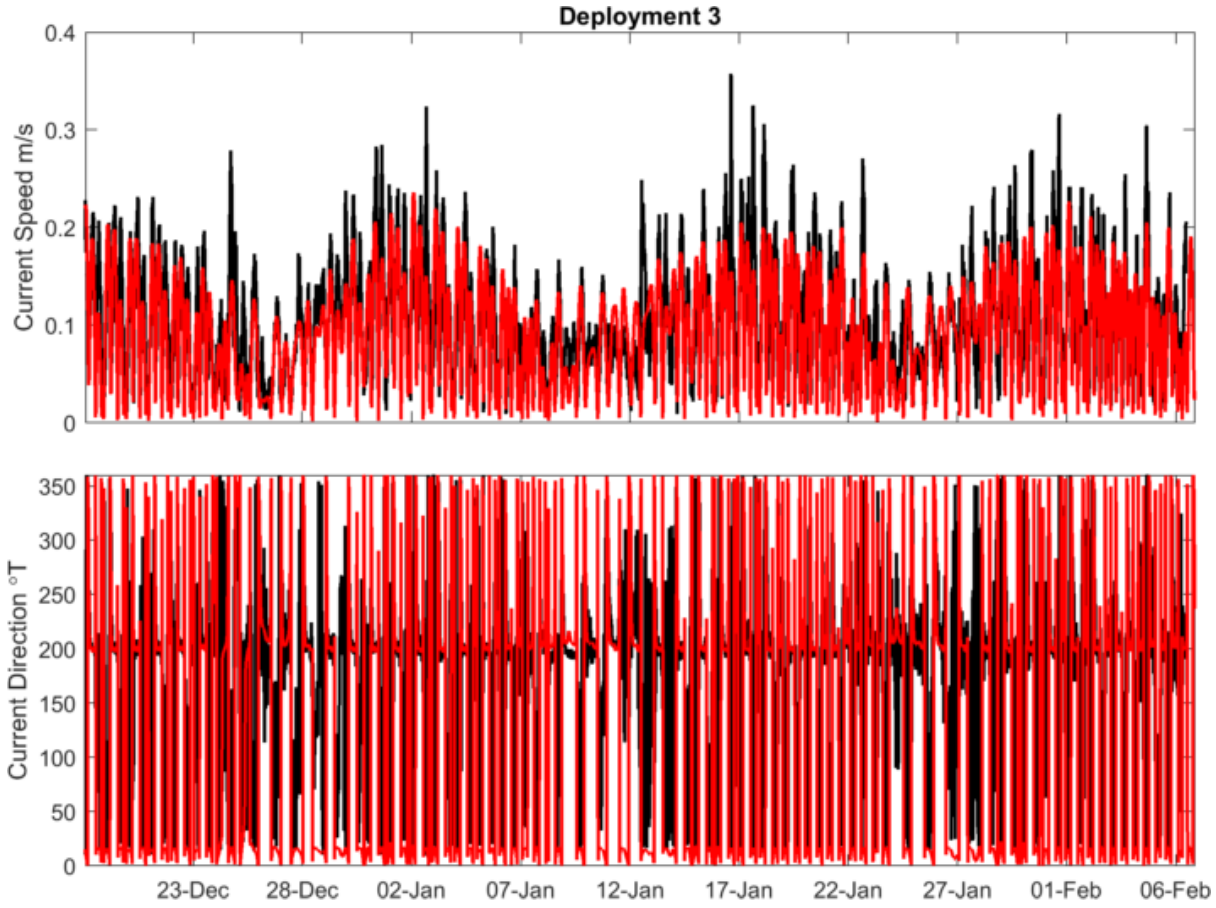

Figure 3.11: Comparison between current speed and direction measured by the ADCP during deployment 2 (Grant *et al*., 2011) and the coupled hydrodynamic and wave Delft3D model.

3.4 Sediment Transport Modelling

Sediment transport modelling was undertaken using the 2DBeach model form the 3DD model suite. The numerical model suite 3DD consists of a full set of marine and freshwater simulations of all physical processes relevant to planning, management and research of our environment. The suite is fully matured, developed over a broad series of science programmes.

Model 2DBeach is a unique beach circulation and sediment transport model that uses a mixed Lagrangian and Eulerian solution scheme to obtain highly accurate simulations over complex natural bathymetries. The height transformation method, plus 2DBeach's many features and simple operation, sets this model apart, and makes it one of the most appealing general-purpose beach models presently available. In one fully coupled computer code, 2DBeach contains:

- A Lagrangian wave height transformation model treating conditions beyond, through and inside the breakpoint
- A non-linear, wave-driven hydrodynamic model,

- A wave angle transformation simulation using a rapid iterative solution and
- A wave and current sediment transport model able to treat multiple grain sizes, "real-time" seabed adjustments and enhanced suspension around the breakpoint under plunging waves

2Dbeach has the capacity to predict features such as rip-currents, sand bar movement, beach transformations, storm erosion and the build-up of beaches after storms. In 2DBeach, the unsteady wave height transformation equations are solved using a combination of Lagrangian and Eulerian methods which eliminates the numerical diffusion errors that are common to purely Eulerian solutions. The Lagrangian scheme also effectively handles the sharp discontinuity in wave heights across the breakpoint. A non-steady, non-linear hydrodynamic model is linked to the wave transformation models through radiation stress terms in the momentum balance equations. The sediment transport model uses a vertically-averaged form of the suspended sediment concentration equations to treat spatial variation in suspended sediment concentration and differential settlement and the consequential seabed "real-time" adjustments.

2DBeach defines particle characteristics by fall velocity. For this project, a grain size of 0.3 mm for the main model runs and sensitivity analysis was carried out using a grain size of 0.13 mm based on the analysis of grain sizes presented in Grant *et al*. (2011). Grain sizes were converted to fall velocities using the method of Soulsby (1997) (equation 102) which yielded fall velocities of 0.035 m/s for the 0.3 mm grain size and 0.01 m/s for the 0.13 mm grain size.

Sea level boundaries were derived from the hydrodynamic model and wave boundary conditions were taken from the measured ADCP record. Sediment thickness files were produced to define non-erodible areas in the model domains over the nearshore reefs. A sediment thickness of 5 m was defined in other areas.

Simulations were undertaken for the 3 scenarios (see Section 3) for winter and for summer. The 3 summer scenarios were rerun for the 0.13 mm grainsize (0.01 m/s fall velocity). The summer and winter sea level and wave boundary conditions for are shown in Figure 3.12

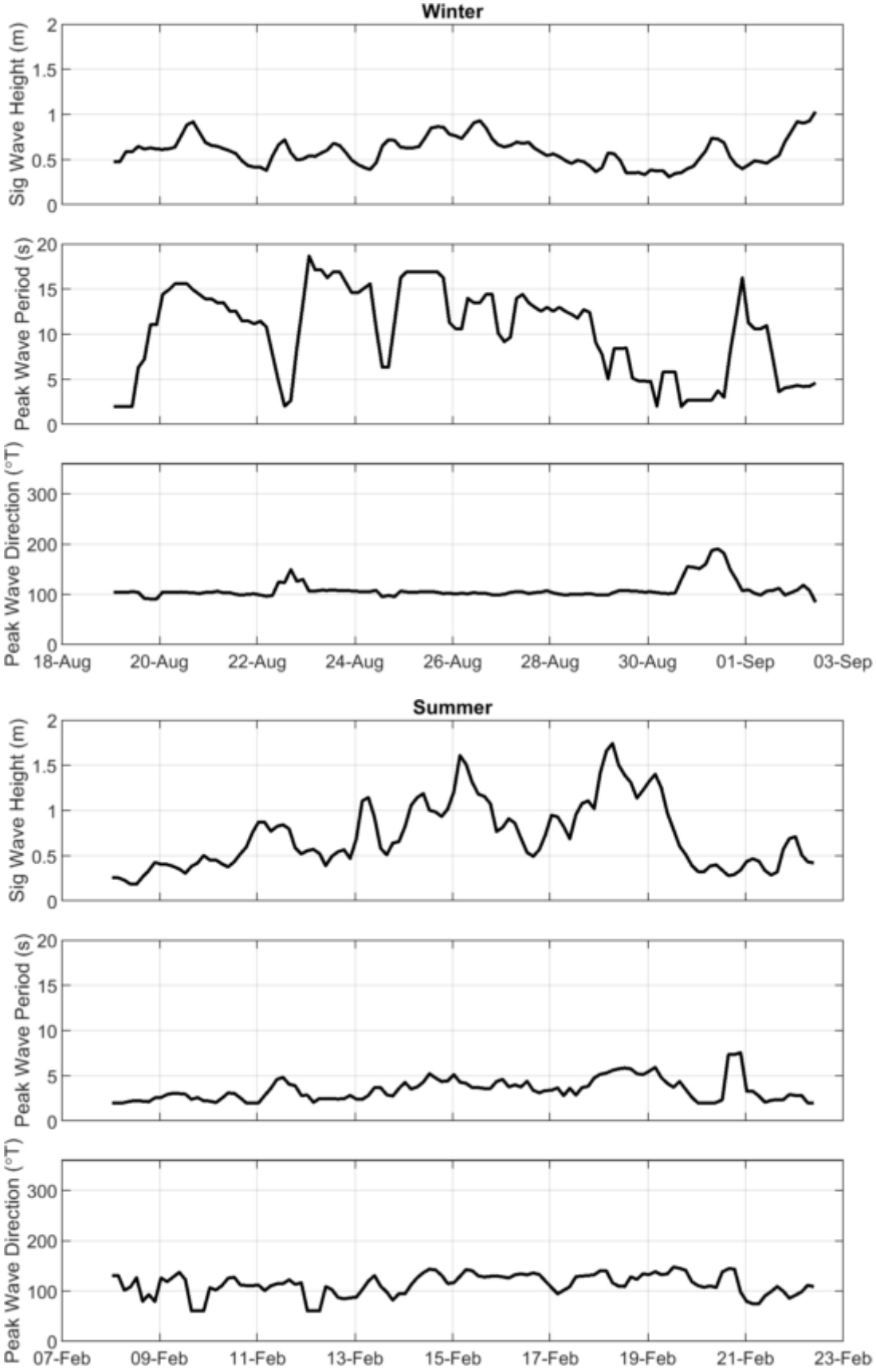

Figure 3.12: Winter (top) and Summer wave height, period and direction boundary conditions for sediment transport modelling.

4 Results

In this section we present results of the wave, hydrodynamic and sediment transport model simulations outlined in Section 3.

4.1 Wave Modelling

The 2001 year long wave model was undertaken for the 3 scenarios: as is, post development and post-development with the vessel in place. Rose plots of the wave climate at the study site for wave height and period (binned by direction) are shown in Figure 4.1 illustrating the dominant wave direction centred on 145º with overall high period waves dominating. The mean wave condition is shown for the 3 scenarios in Figure 4.2, Figure 4.3 and Figure 4.4. These results clearly illustrate that the wave angle is oblique to the coast and there is a resultant wave shadow to the north west of the causeway and the vessel. With the causeway in place, the shadow of the average wave height extends approximately 110 m along the coastline and with the addition of the ship this extends to 190 m. The reduction in wave energy reduces with distance from the causeway, but within the shadow the average wave height reduces from approximately 0.9 m to 0.6 m.

These results also highlight that even though the vessel is located in deep water (~ 17 m LAT at the most shallow end) it still has a significant impact on the sediment-mobilising wave heights in the shallow nearshore where most sediment transport is expected.

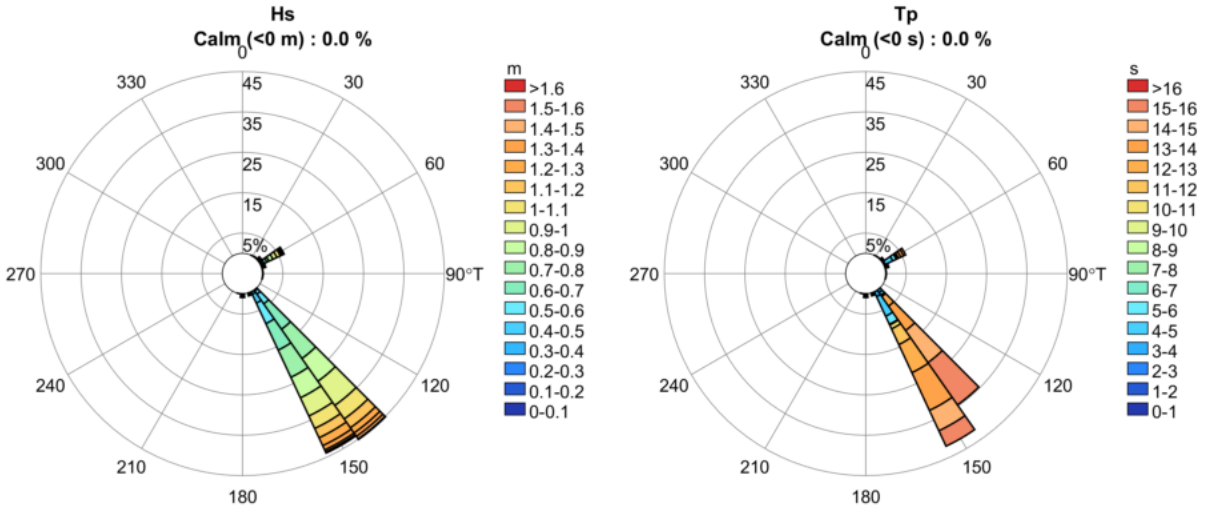

Figure 4.1: waves roses at the study site showing Significant Wave Height (Hs) and Peak Period (Tp) at the study site for 2001.

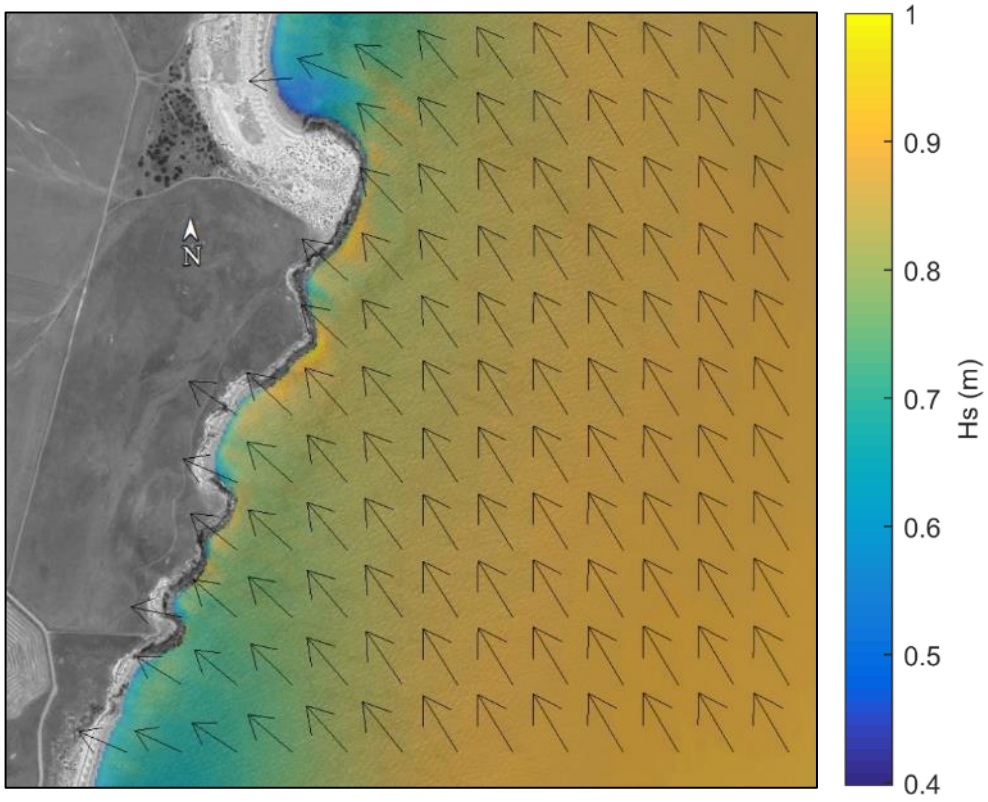

Figure 4.2: Mean Significant wave height (Hs) and Peak Direction (Dp) for 2001 at the study site for the as it scenario.

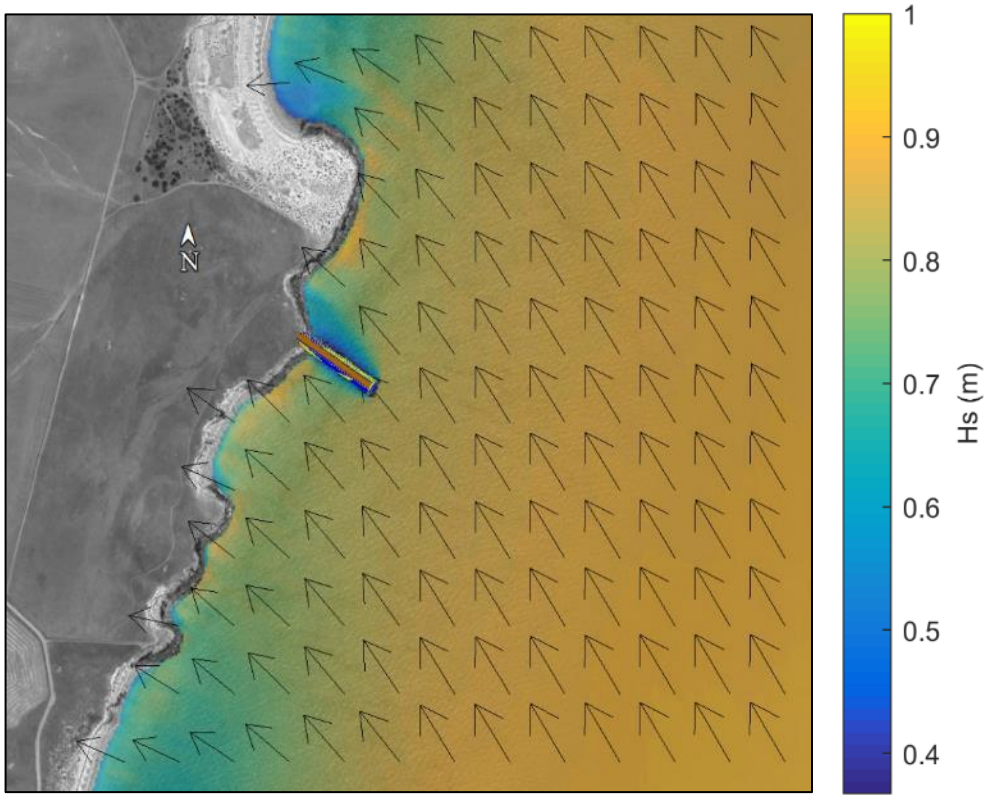

Figure 4.3: Mean Significant wave height (Hs) and Peak Direction (Dp) for 2001 at the study site for the post-development scenario.

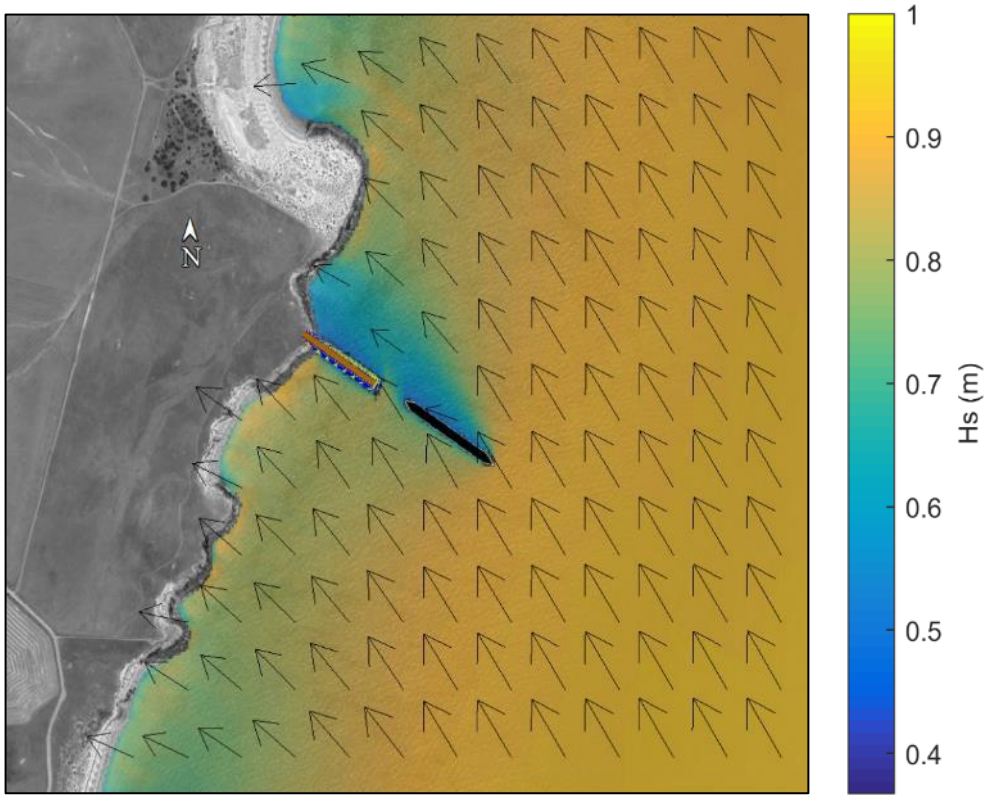

Figure 4.4: Mean Significant wave height (Hs) and Peak Direction (Dp) for 2001 at the study site for the post-development scenario with the ship in place.

4.2 Coupled Hydrodynamic and Wave Modelling

The coupled hydrodynamic/wave model was run for two month long scenarios (summer and winter) and the results of these simulations are presented here.

A complete tidal cycle of currents going from low tide (hour 1) to high tide (hour 6) and back to low tide (hour 11) are shown in Figure 4.5, Figure 4.6 and Figure 4.7. These images illustrate the northly flow during the incoming tide and southerly flow during the outgoing tide. They also show the gyres that form in the lee of the outcrop to the south of the study site and the increased currents around the headland to the north.

Vector averaged residual currents are shown for the pre and post development (but without the presence of the loading ship) scenarios for summer (Figure 4.8) and winter (Figure 4.9). Difference plots of the pre and post development scenarios are shown in Figure 4.10 for summer and winter. Residual currents show the effective long term drift at each model cell and can provide an indication of pathway of suspended material. These plots show that the built structure leads to average increases in the northerly component of the currents to the south of the causeway and average increases in the southerly component of the currents to the south of the causeway.

Wave driven currents in the immediate vicinity of the proposed development will be reduced by up to 0.04 m/s from baseline speeds of 0.05 m/s. Increases in wave driven current speeds of approximately 0.03 m/s are expected around the headland to the north of the causeway leading into Rogers Beach from baseline speeds of 0.25 m/s. Between the pocket beach to the south and Lipson island, some small increases in wave driven current speeds of approximately 0.01 m/s are predicted.

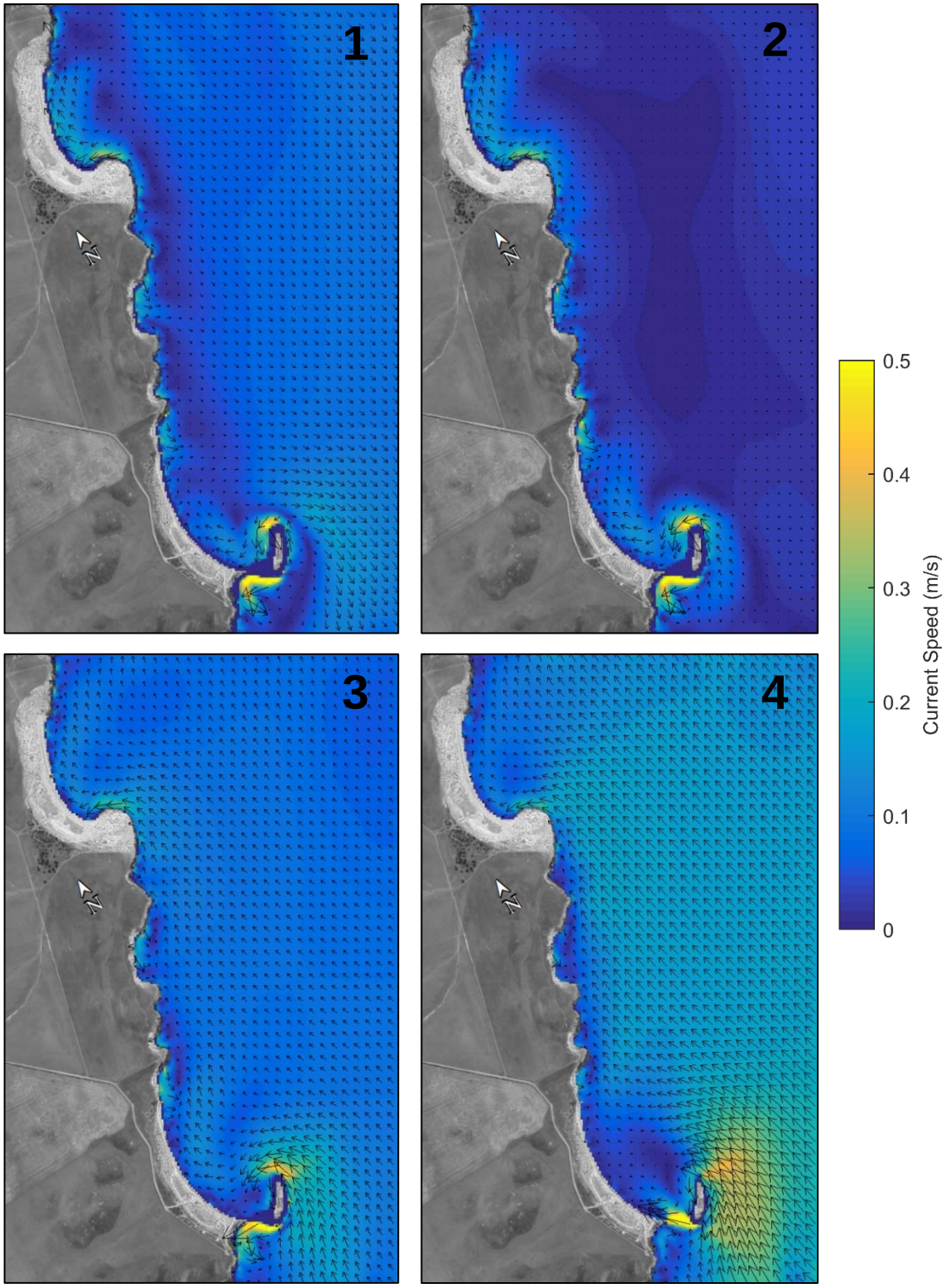

Figure 4.5: Currents speeds during hours 1 to 4 of the tidal cycle

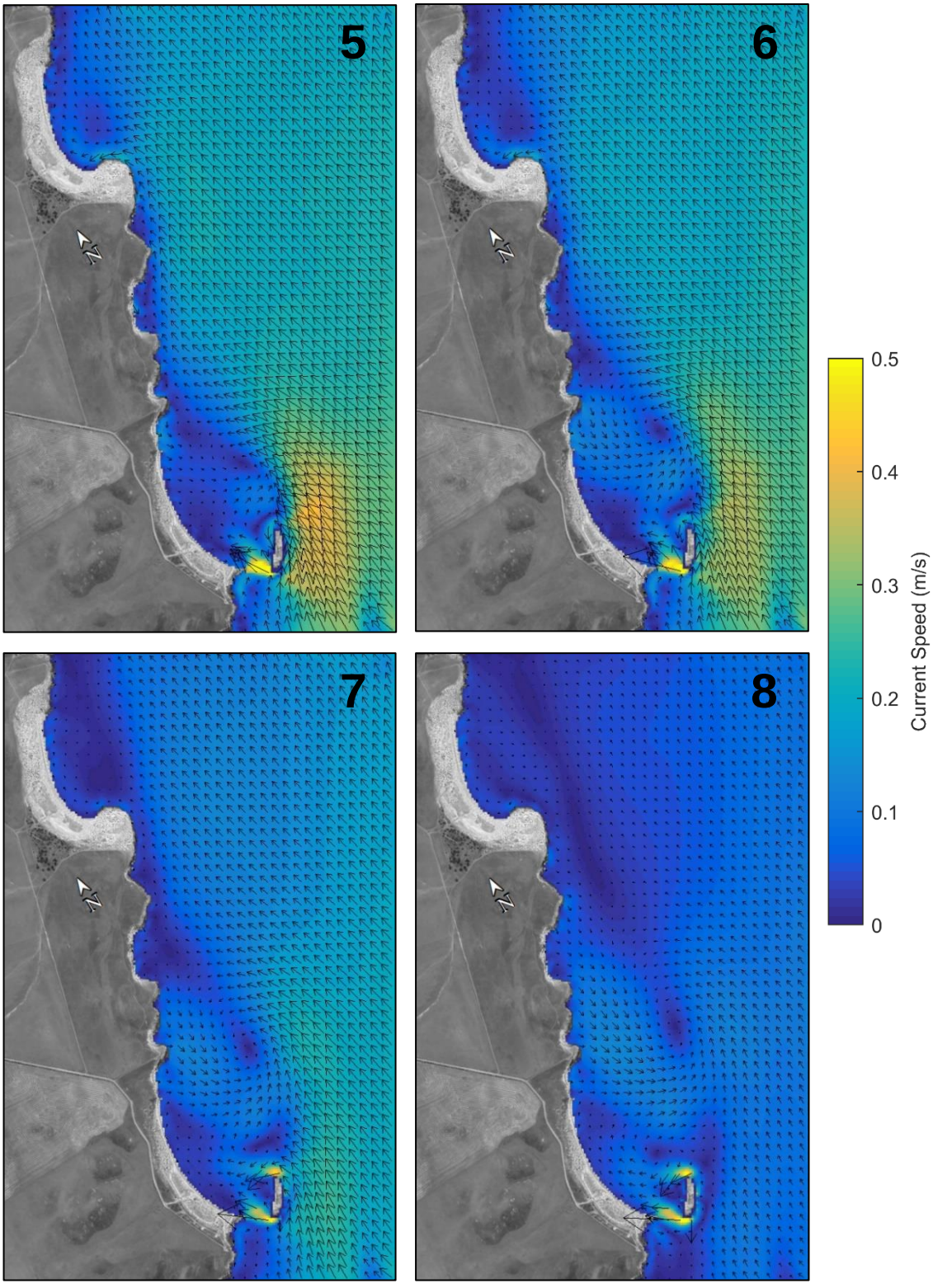

Figure 4.6: Currents speeds during hours 5 to 8 of the tidal cycle

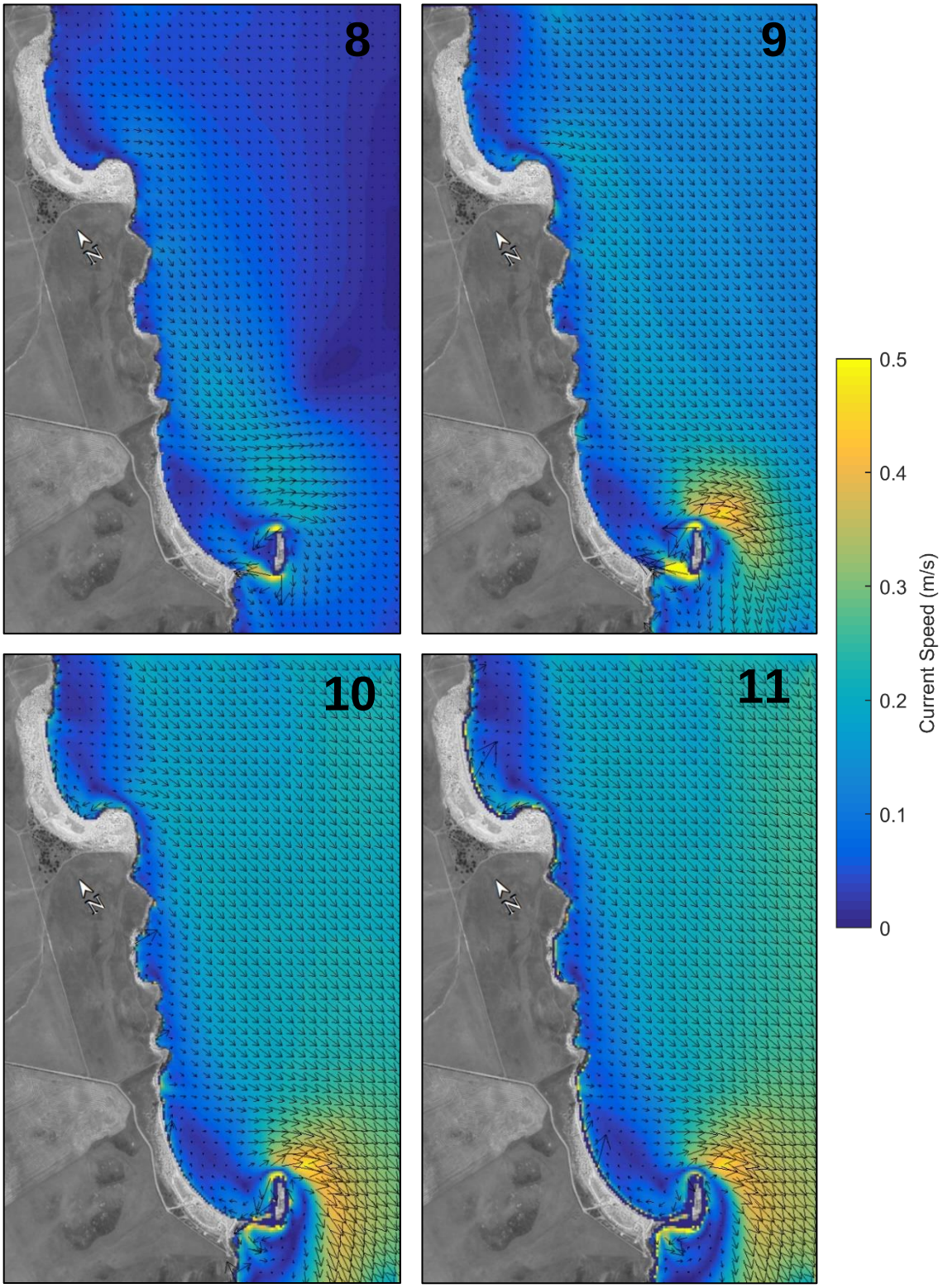

Figure 4.7: Currents speeds during hours 8 to 11 of the tidal cycle.

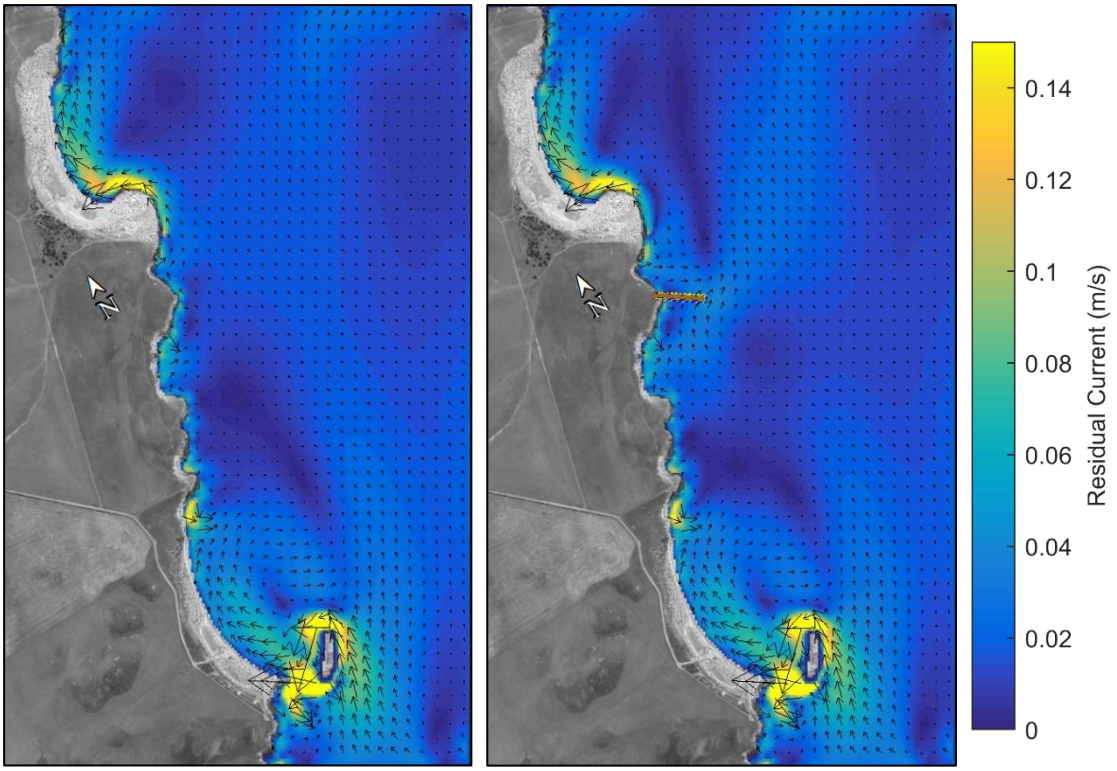

Figure 4.8: Summer residual currents pre (left) and post (right) development.

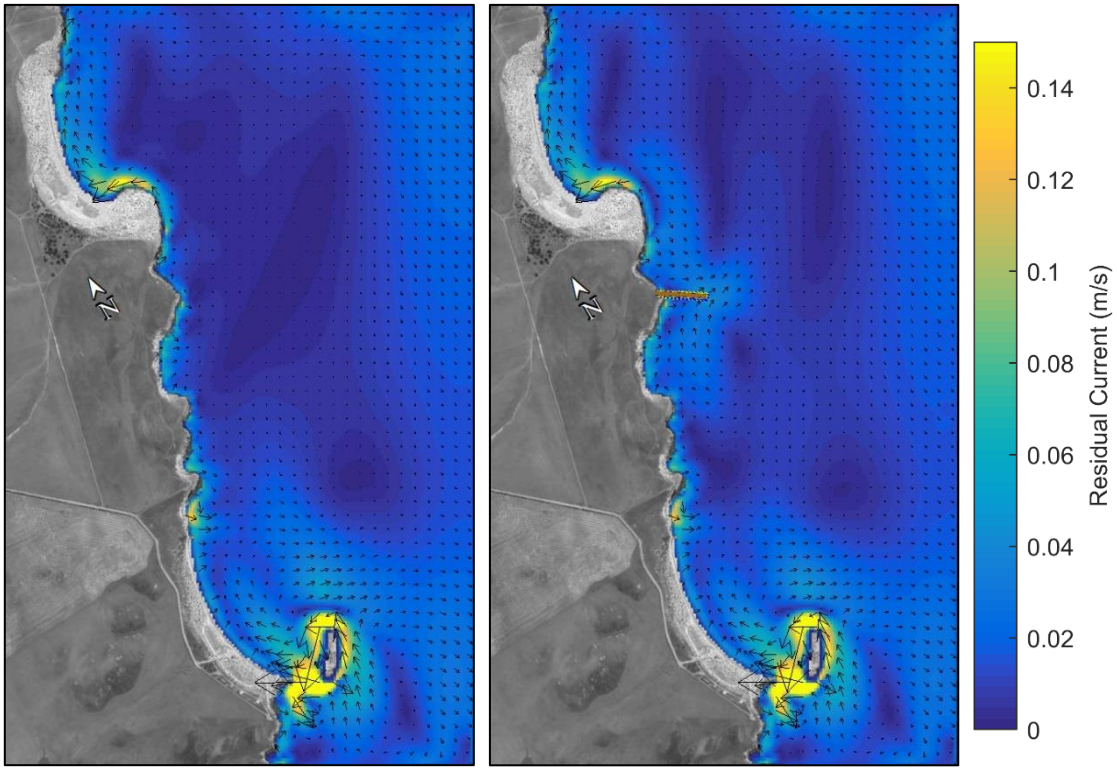

Figure 4.9: Winter residual currents pre (left) and post (right) development.

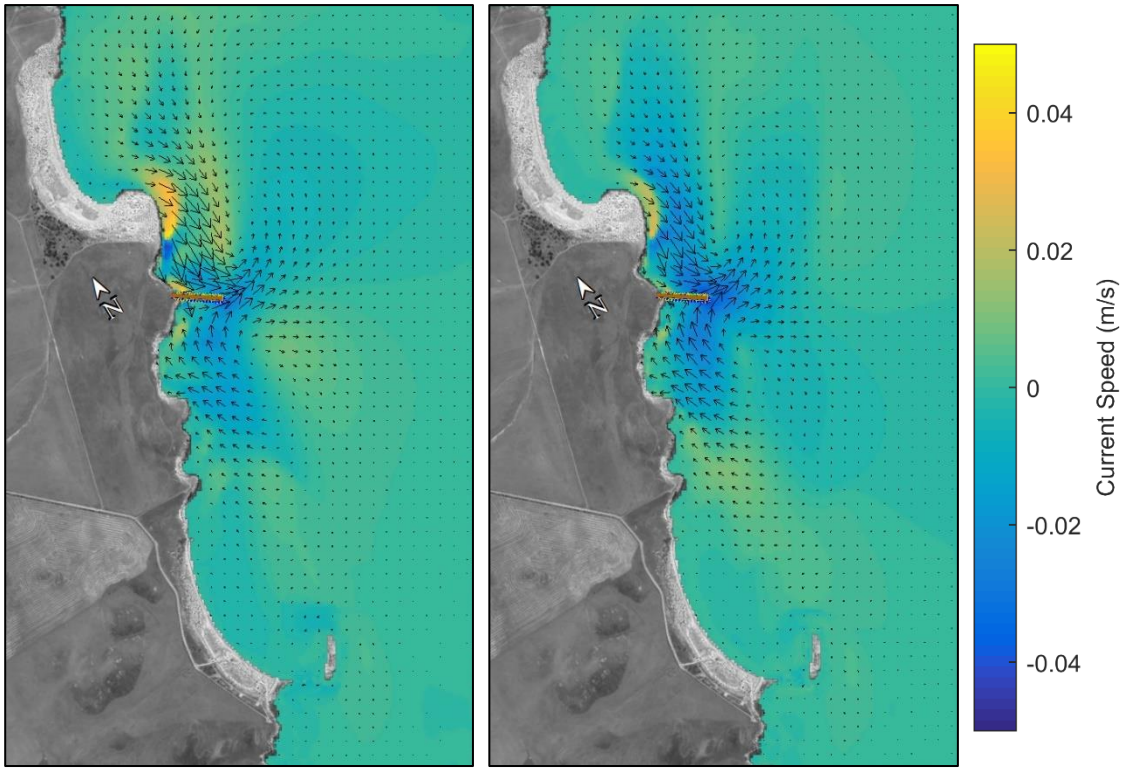

Figure 4.10: Differences in residual currents pre and post development for summer (left) and winter (right).

4.3 Sediment Transport Modelling

Results from the 13 day model runs were scaled up to provide estimated annual accumulation and deposition patterns. For the as is scenario, the accumulation and erosion results were scaled by the following relationship

$$S_A = \frac{365.25}{13} S_n$$

Where S_A is the annual sedimentation and S_n is the modelled sedimentation over 13 days.

The results of the post development scenario were scaled up using a weighted average of the development with and without the vessel in the berth using the following relationship:

$$S_{A\_D} = \frac{60}{365.25} \times \frac{365.25}{13} S_{n\_D} + \frac{365.25 - 60}{365.25} \times \frac{365.25}{13} S_{n\_S}$$

Where S_A is the annual sedimentation due the proposed development including the intermittent presence of the vessel, S_{A_D} is the 13 day sedimentation taking into account the presence of the development and S_{A_S} is the 13 day sedimentation taking into account the presence of the development and the presence of the vessel in the berth.

The results of the sediment transport modelling show the difference in annual sedimentation between the baseline (as is) condition and the annual sedimentation including the presence of the development and the intermittent presence of the vessel.

Estimated annual changes in accretion and erosion due to the proposed development are shown in Figure 4.11 and Figure 4.12 for grain sizes of 0.3 mm and 0.13 mm respectively. Sediment with a grain size of 0.13 mm is more mobile than sediment with a grain size of 0.3 mm and so can be considered the worst, or most conservative, case. Annual sedimentation was calculated by averaging the winter and summer annual changes in accretion and erosion due to the presence of the proposed development. Greater accretion in the nearshore on the reefs should be treated with caution as sediment is unlikely to settle on the rocky substrate. The results indicate broad post-development accretion to the south of the development between 0.01 m/annum and 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.04 m/annum (2 m in 50 years) in localised areas. Broad post-development erosion to the north of the structure is predicted to be between 0.01 m/annum to 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.03 m/annum (1.5 m in 50 years) in places. The pocket beach to the south shows predicted post-development accretion of between 0.01 m/annum and 0.04 m/annum in places. Rogers Beach to the north shows a small increase in post-development erosion of up to 0.005 m/annum. The seabed extent affected by ranges of accretion and erosion rates are presented in Table 4.1.

Table 4.1: Area affected by the development in terms of change to annual accretion and erosion rates.

Type	Range of Accretion/Erosion change (m/annum)	Area Affected Lower Limit (km^2)	Area Affected Upper Limit (km^2)
Accretion	0.005 to 0.01	0.0845	0.1673
Accretion	0.01 to 0.02	0.0109	0.1199
Accretion	0.02 to 0.03	0.0000	0.0324
Accretion	0.03 to 0.04	0.0000	0.0039
Erosion	-0.005 to -0.01	0.0004	0.2014
Erosion	-0.01 to -0.02	0.0000	0.0786
Erosion	-0.02 to -0.03	0.0000	0.0248
Erosion	-0.03 to -0.04	0.0000	0.0002

The changes in hydrodynamics, waves and consequently the sediment transport regime, decrease with distance from the development and are expected to be negligible around Lipson Cove and Lipson Island. Additionally, Lipson cove is south of the development in a northward moving sediment transport regime, as demonstrated by the numerical modelling and the presence and orientation of zeta beaches all along this coast.

An equilibrium in accretion/erosion will be reached at some point though being chronic this is likely over a larger number of years. ‘Chronic’ here indicates persistence over time rather than being indicative of severe impacts. However, it is unlikely that a steady state will result until or

unless the accretion on the southern side progresses to a stage where it is bypassing the solid/nearshore part of the causeway. If this was left to occur, there would be consequent erosion of Rogers beach to the north. Therefore, annual monitoring with potential sand transfer from the southern to the northern side of the structure is recommended to ensure the coastal environment is protected; as noted above, in this relatively benign environment, sand transfer is likely to be required infrequently.

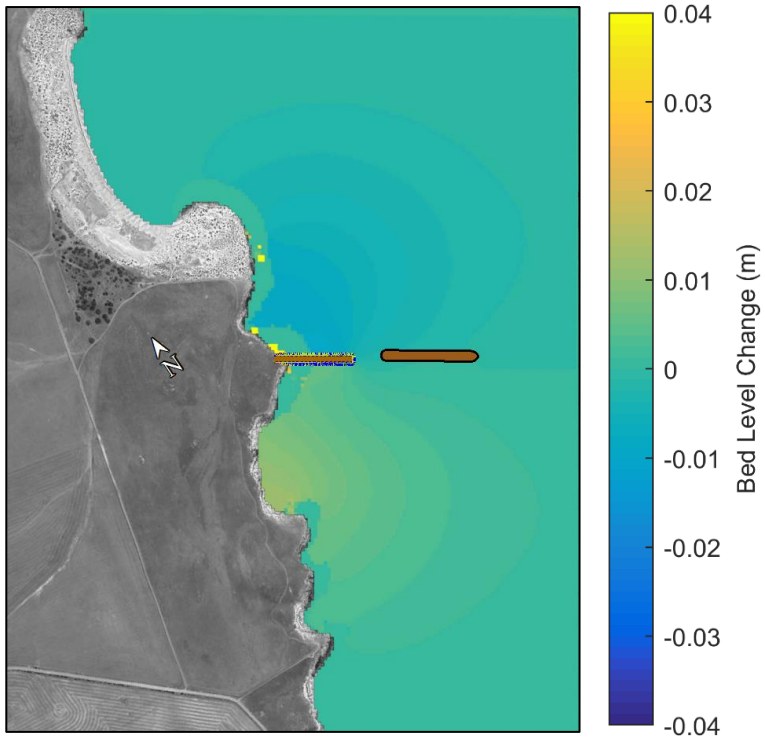

Figure 4.11: Difference in annual sediment accumulation and erosion patterns between baseline and post development scenarios for a grain size of 0.3 mm. Positive values indicate increased accumulation and negative values indicate increased erosion due to the presence of the development.

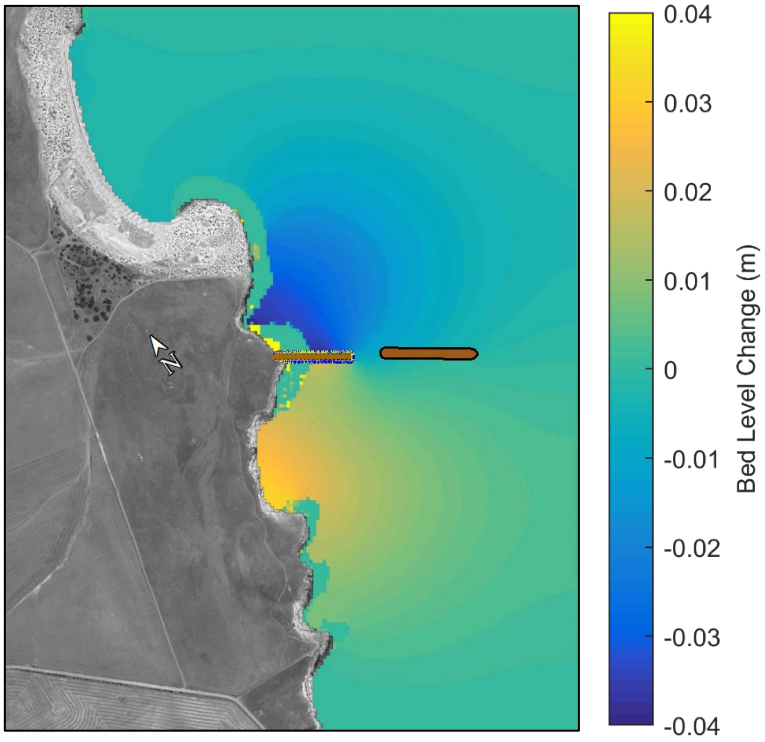

Figure 4.12: Difference in annual sediment accumulation and erosion patterns between baseline and post development scenarios for a grain size of 0.13 mm. Positive values indicate increased accumulation and negative values indicate increased erosion due to the presence of the development.

5 Conclusions

A series of models were developed to simulate the wave climate, coupled hydrodynamic and wave flow regime and the sediment transport regime. Where data was available, these models were calibrated against measured data. The models extensively used the data collected as part of a pervious study in the area by ASR Ltd (Grant *et al*., 2011).

The wave model calibrated well against measured data although it tended to slightly underestimate peaks in wave height. This is likely due to the lack of detailed local wind data for the area. The hydrodynamic model calibrated well against sea level and current data although it sometimes underestimated peak current velocities.

The sediment transport model simulated a period of 13 days in winter and summer and was used to simulate the coastline as is today, as well as with the proposed causeway in place and with the causeway and loading vessel in place. The results were scaled up to estimate annual changes in sediment transport due to the proposed development.

Sediment with a grain size of 0.13 mm is more mobile than sediment with a grain size of 0.3 mm and so can be considered the worst, or most conservative, case. Annual sedimentation was calculated by averaging the winter and summer annual changes in accretion and erosion due to the presence of the proposed development. Greater accretion in the nearshore on the reefs should be treated with caution as sediment is unlikely to settle on the rocky substrate. The results indicate broad post-development accretion to the south of the development between 0.01 m/annum and 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.04 m/annum (2 m in 50 years) in localised areas. Broad post-development erosion to the north of the structure is predicted to be between 0.01 m/annum to 0.02 m/annum (0.5 m to 1 m in 50 years) but up to 0.03 m/annum (1.5 m in 50 years) in places. The pocket beach to the south shows predicted post-development accretion of between 0.01 m/annum and 0.04 m/annum in places. Rogers Beach to the north shows a small increase in post-development erosion of up to 0.005 m/annum. The seabed extent affected by ranges of accretion and erosion rates are presented in the following table:

Area affected by the development in terms of change to annual accretion and erosion rates.

Type	Range of Accretion/Erosion change (m/annum)	Area Affected Lower Limit (km^2)	Area Affected Upper Limit (km^2)
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Accretion	0.02 to 0.03	0.0000	0.0324
Accretion	0.03 to 0.04	0.0000	0.0039
Erosion	-0.005 to -0.01	0.0004	0.2014
Erosion	-0.01 to -0.02	0.0000	0.0786
Erosion	-0.02 to -0.03	0.0000	0.0248
Erosion	-0.03 to -0.04	0.0000	0.0002

The changes in hydrodynamics, waves and consequently the sediment transport regime, decrease with distance from the development and are expected to be negligible around Lipson Cove and Lipson Island. Additionally, Lipson cove is south of the development in a northward moving sediment transport regime, as demonstrated by the numerical modelling and the presence and orientation of zeta beaches all along this coast.

An equilibrium in accretion/erosion will be reached at some point though being chronic this is likely over a larger number of years. However, it is unlikely that a steady state will result until or unless the accretion on the southern side progresses to a stage where it is bypassing the solid/nearshore part of the causeway. If this was left to occur, there would be consequent erosion of Rogers beach to the north. Therefore, annual monitoring with potential sand transfer from the southern to the northern side of the structure is recommended to ensure the coastal environment is protected noting that in this relatively benign environment, sand transfer is likely to be required infrequently.

Monitoring locations should be defined on the northern side of the proposed structure and the southern end of the beach to the north (some 500 m). Trigger levels for remediation actions should be defined in line with acceptable levels of shoreline erosion or ecological considerations. It is important to note that sediment transport rates are relatively low at this site, which means sand transfer to mimic the current sediment transport regime once the structure has been built will be relatively infrequent.

Several options were discussed with the client regarding possible design alterations that might mitigate the effect of the proposed wharf in particular on the sediment transport regime. The two options were.

1. Realignment of causeway so it is better aligned to swells
2. Adding culverts that pass through the causeway to allow sediment throughput

Addressing the first solution, realignment of the causeway will not alter its overall effect on the sediment transport regime. The causeway presents a hard structure that blocks the

predominantly northward movement of sediment. Even if realigned it will remain an impediment to the long shore movement of sediment. Regarding the second solution, culverts built into the causeway will likely become blocked reasonably quickly as suspended sediment will enter the culverts and, in the absence of wave energy, will settle inside. In the absence of wave energy inside the culvert, there will be a build-up of sediment since tidal flows will not be strong enough to resuspend the sediment in the absence of wave energy.

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