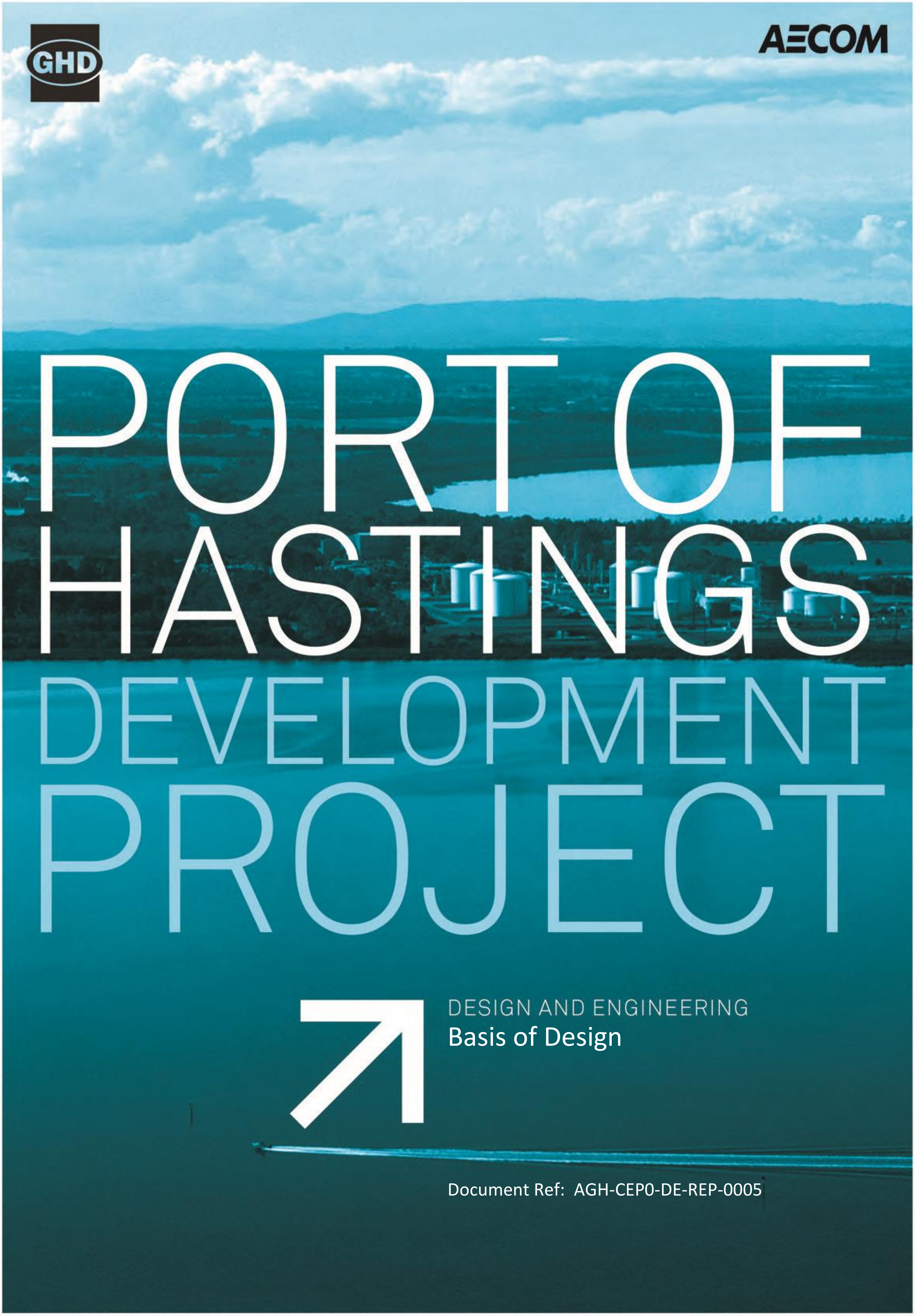

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AECOM

PORT OF HASTINGS DEVELOPMENT PROJECT

DESIGN AND ENGINEERING

Basis of Design

Document Ref: AGH-CEP0-DE-REP-0005

In May 2016 the Special Minister of State asked Infrastructure Victoria to provide advice on the future capacity of Victoria's commercial ports. Specifically, the Minister has asked for advice on when the need for a second container port is likely to arise and which variables may alter this timeline. The Minister has also asked for advice on where a second container port would ideally be located and under what conditions, including the suitability of, and barriers to investing in, sites at the Port of Hastings and the Bay West location.

In undertaking this task, Infrastructure Victoria reviewed work that was completed as part of the Port of Hastings development project before it was cancelled in 2014. This document forms part of the initial work undertaken for the proposed port development at Hastings. Infrastructure Victoria considers that much of the previous Hastings work, although preliminary in nature, is relevant and suitable for informing a strategic assessment. Therefore, Infrastructure Victoria has made the reports previously commissioned for the development project part of the evidence base on which Infrastructure Victoria will use in providing the Minister with advice.

The opinions, conclusions and any recommendations in this document are based on conditions encountered and information reviewed at the date of preparation of the document and for the purposes of the Port of Hastings Development Project.

Infrastructure Victoria and its consultants have used the information contained in these reports as an input but have not wholly relied on all the information presented in these reports.

DRAFT

Port of Hastings Development Project – Design and Engineering

Basis of Design

Client: Port of Hastings Development Authority

ABN: 33 737 350 749

Prepared by the AECOM + GHD Joint Venture

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Prepared by	Ben Gray, Andrew McArthur, Stephen Martin & Ian Cookson
Reviewed by	Venket Naidu, Richard Clarke & Peter Fountain

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	24-Sep-14	Draft	Peter Fountain Project Director	Peter Fountain *
B	5-Dec-14	Second Working Draft	Peter Fountain Project Director	Peter Fountain *
C	27-Feb-15	Incorporating TAG comments	Richard Clarke Technical Manager	Richard Clarke *
0	15-May-15	Final Working Draft	Peter Fountain Project Director	Peter Fountain *

Table of Contents

1.0 Introduction

1.1 Background

The Victorian Government has identified the Port of Hastings as the suitable site for additional capacity for international container trade as the Port of Melbourne reaches capacity, expected by early to mid-2020s. The Port of Hastings will initially complement the Port of Melbourne, then compete with the Port of Melbourne and eventually replace the container related business at the Port of Melbourne.

The Victorian Government established the Port of Hastings Development Authority on 1 January 2012 as the first key step in fast tracking the development of Hastings as a future container port with the aim of providing increased capacity and competition in the container ports sector.

The Authority's objectives for the Project are to:

- Make a positive contribution to Victorian and national economic growth and productivity over the long term;
- Create a commercially viable container Port which services the long term needs of Victoria;
- Deliver a world-class competitive Port which is attractive to shipping lines and supply chain owners and operators;
- Achieve a minimum port capacity of nine million TEU by 2060 (the first stage operational in mid 2020s) which is integrated into the Victorian freight network;
- Construct, operate and maintain a safe and sustainable port;
- Optimise benefits and manage impacts of the Project on the community, existing customers and the environment; and
- Maximise whole-of-life value for money for government.

1.2 Purpose of this Document

The objective of the Design and Engineering (D&E) Work Stream services is to undertake a range of technical assessments, as well as provide ongoing advice and guidance to the Authority to assist the Authority to:

- Complete applicable environmental impact assessments and approvals requirements for Victorian and Commonwealth decision-makers.
- Produce a Business Case for the Project to inform a final development decision for the Victorian Government.

This document outlines the criteria and rationale to be used for the development of port layout options, engineering solutions, preliminary design and capital/operating cost estimates as required to inform the above scope of work.

1.2.1 Status of this Document

This revision of the document is based on Part 1 studies as at the end of September 2014. The document is not complete, and will need to be updated as associated work stream studies are progressed.

These further studies include:

- articulation of the port vision to confirm project objectives,
- trade demand studies (forecasting) to confirm trade types and volumes,
- vessel fleet forecasting studies,
- consultations with the Harbourmaster and the Port Phillip Sea Pilots regarding vessel and channel operations,

- consultation with industry regarding terminal functional requirements,
- traffic modelling and 'Concept of Rail Operations' studies to confirm road and rail mode share and operational requirements,
- environmental studies to confirm baseline data and environmental management requirements,
- hydrodynamic studies to confirm met-ocean criteria and assumptions and
- dredge material management studies.

Consequently, this is a live document. It is incumbent on the user to ensure they use the current revision, which will be accessible to authorised users as a "controlled document".

1.3 Guiding Principles for Port Planning and Design

This section summarises the design principles of the project and the various components forming part of the Design and Engineering work package.

The following sections are placeholders until the port vision work is undertaken.

1.3.1 Functionality

Planning and design is required to:

- enable development of a commercially viable, efficient and internationally competitive port.
- satisfy environmental, safety and operational criteria;
- provide appropriate berth lengths and terminal areas in stages to satisfy future operational and commercial needs;
- provide flexibility for a range of possible terminal operating systems and different degrees of sophistication and automation
- provide adequate landside road and rail 'transport connectivity' to meet projected demands;
- provide safe and cost effective approach channels with flexibility for further development as trade and vessel trends dictate;
- provide land for port centric logistics operations to optimise distribution within the state of Victoria and beyond.

In addition the importance level of the infrastructure such as the wharf structure will need to be decided to inform the design standards adopted in relation to environmental return periods and performance. Post Disaster Structures or Exceptional Structure classifications will need to be considered.

1.3.2 Sustainability

Planning and design of the port will be in accordance with sustainability principles outlined in the Sustainability and Durability Principles Summary Report (Reference 7). This includes adaptability to future climate change and to reduce energy demand and harmful emissions.

1.3.3 Environmental

The planning and design outcomes will need to support the environmental values of Western Port. Specifically, the planning will consider the findings of numerical modelling 'sensitivity tests', ecological conceptual models, risk analyses and multi-criteria assessments that are being undertaken concurrently by the Environment and Social workstream.

1.3.4 Durability

The basis of design includes parameters that specify 'design life' and 'durability' requirements for the future assets of the port. These are intended to support the development of a sustainable design, construction and operational practice, adopting a whole-of-life-cycle approach, with minimal future disruption due to maintenance.

1.3.5 Serviceability

Future settlement and movement design parameters are required for ongoing serviceability of berth structures, pavements and foundations. These will recognise the requirements for terminal operations for a range of operating systems. These parameters also need to recognise the realities of the site ground conditions and the economical and practical limits of ground improvement achievable in cost-effective and timely terminal development. Residual settlements will need to be catered for in the engineering designs without undue cost or long term loss of functionality or unacceptable maintenance and operational disruption.

The need to minimise other types of maintenance disruption is an important performance objective that needs to underpin the port designs.

1.3.6 Safety in Design

Safety in design (SiD) is a process aimed at preventing incidents, injuries and disease by considering hazards and enhancing safety to the extent possible during a project design phase. This process considers all stages of the asset life, ie construction, operation, expansion, maintenance and demolition.

For this project, it is recognised that the identification of critical health and safety related risks that may affect the project development is of prime importance. This as a minimum shall consider geotechnical risks, ground contamination, future emissions, operational scenarios, vessel movements and hazard classes and land use planning.

1.3.7 Constructability

Consideration of construction issues, methods, staging and program requirements will be necessary to ensure the facility is cost effective, planned with a realistic schedule and expandable when required and in a timely and efficient manner.

1.3.8 Future Proofing

Planning and design need to provide flexibility to accommodate continuing change including:

- Existing port operations
- trade characteristics
- vessel sizes and cargo exchange
- terminal operating systems
- levels of terminal automation
- growth in rail share
- further evolution and enforcement of sustainability principles
- climate change including sea level rise.

2.0 Existing Conditions

2.1 General

This section summarises the existing conditions within the port development area, port precincts and port environs.

Further information of the existing condition can be found on the Port of Hastings Webmap (https://projectmap.ghd.com/pohda/) developed by the Authority for this project. This website will be updated as the project progresses with more relevant information.

Extensive references in this section are made to the Port of Hastings 2013 Descriptive Report (Reference 3). This was prepared as an overview of the existing knowledge base and geographical context for the Port of Hastings.

2.2 Survey Data

2.2.1 Datum

Horizontal datum for the project is Geocentric Datum of Australia 1994 (GDA94), and projected to Map Grid of Australia, Universal Transverse Mercator Zone 55 (MGA z55).

Chart Datum (CD) at Stony Point has been adopted as the vertical datum for the marine and terminal infrastructure. For the port precincts and port environs, Australian Height Datum (AHD) has been adopted as the vertical datum. Chart Datum at Stony Point is recorded as being 1.69 m below Australian Height Datum (AHD), (Victorian Tide Tables, 2014).

It should be noted that tidal monitoring at Long Island Point is ongoing and the development of a project datum for Long Island Point is expected at a future stage of the project. This is being undertaken by the Hydrodynamic work stream. The project datum will be adopted when it is established.

2.2.2 Bathymetry

The bathymetry data is sourced from Spatial Information Infrastructure, Department of Sustainability and Environment, in particular the Coastal 2.5m resolution DEM and reduced to Lowest Astronomical Tide (LAT) for Stony Point, which is approximately the same as chart datum. This is available on the Port of Hastings Webmap (https://projectmap.ghd.com/pohda/). Further work is planned to be undertaken to fill in the missing gaps within this data set.

Relevant navigation charts include:

AUS 150 – Western Port (Edition No. 2 dated 4 Jun 2010)

AUS 151 – Western Port – Entrance and North Arm (Edition No. 2 dated 4 Jun 2010)

AUS 152 – Western Port – Hastings Bight, Hanns Inlet, Rutherford Inlet and Crib Point (Edition No. 2 dated 4 Jun 2010)

2.2.3 Topography

The topography of Western Port is described in the Port of Hastings 2013 Descriptive Report. Terrestrial elevation data and feature survey has been compiled for the SUZ1 area as described in the report from Watsons (Reference 5).

2.2.4 Cadastral and Planning

The Planning Zones affecting the Port of Hastings Site are shown in Figure 2-1. Further information including cadastral parcels and planning overlays, are shown on the Port of Hastings Webmap (https://projectmap.ghd.com/pohda/) and in the Port of Hastings 2013 Descriptive Report (Reference 3). Planning zones, overlays and cadastral parcels are sourced from the Department of Environment and Primary Industry.

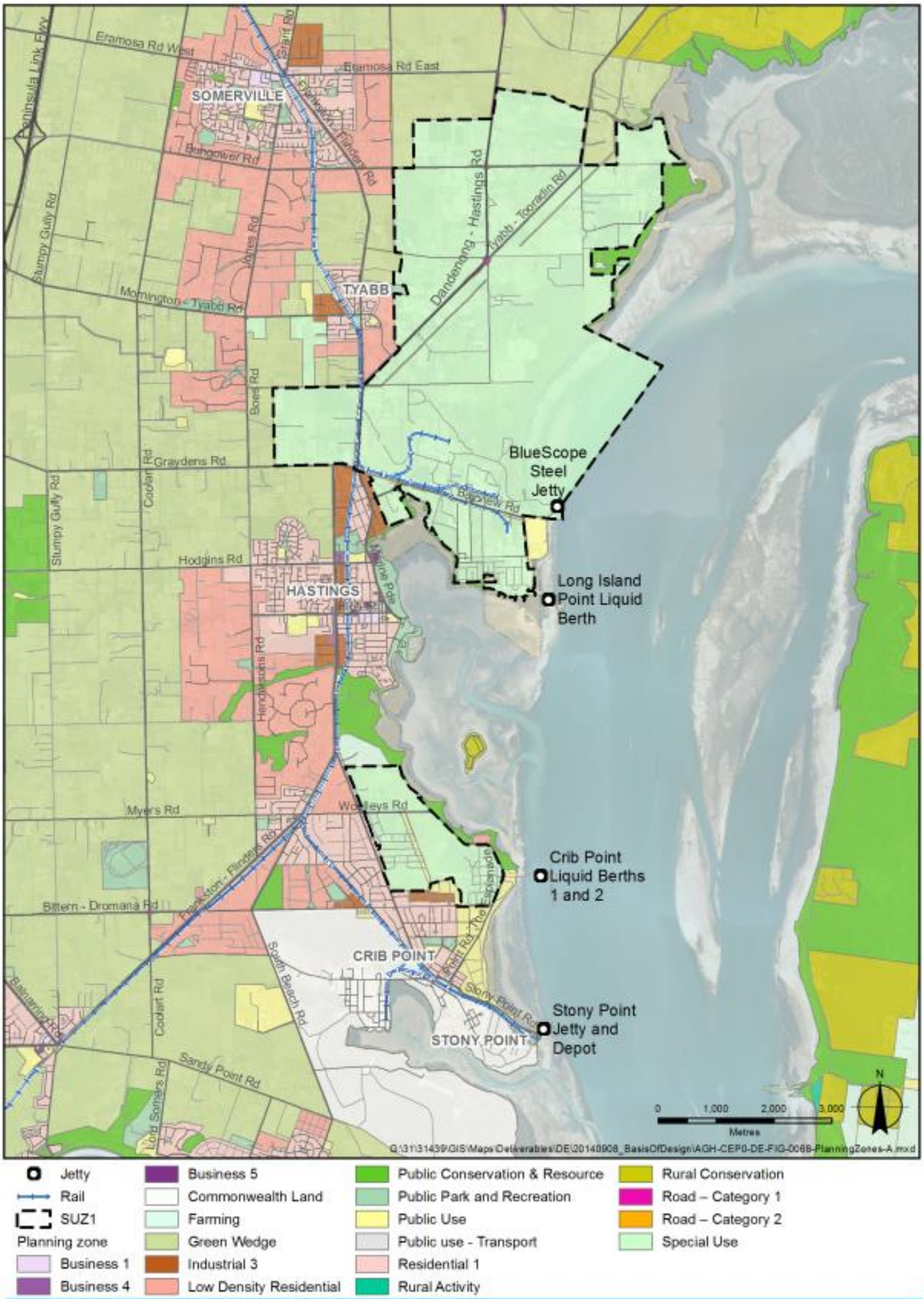


Figure 2-1. Planning zones over and surrounding the Port of Hastings

2.3 Ground Conditions

This section provides a brief summary of the geology of the project area. Details of the geotechnical conditions across the site are provided in the Geotechnical Interpretative Report (Reference 8) and an associated three dimensional ground model.

2.3.1 Regional Setting

Near surface materials across Western Port comprise shallow marine deposits underlain by widespread non-marine sands, sandy clays and minor gravels deposited from the Miocene to the early Pleistocene. There are extensive deposits of now stabilized dune sands that were active during Pleistocene glacial times of low sea level. The most recent marine submergence occurred in the last 6,000 years during the Holocene post-glacial rise in sea level. The northern and north eastern margin of the bay was an extensive and low-lying freshwater wetland, now almost completely drained. Extensive stands of mangrove and salt marsh fringe much of the coastline of the bay and the islands. The geology and morphology of Western Port is shown in Figure 2-2.

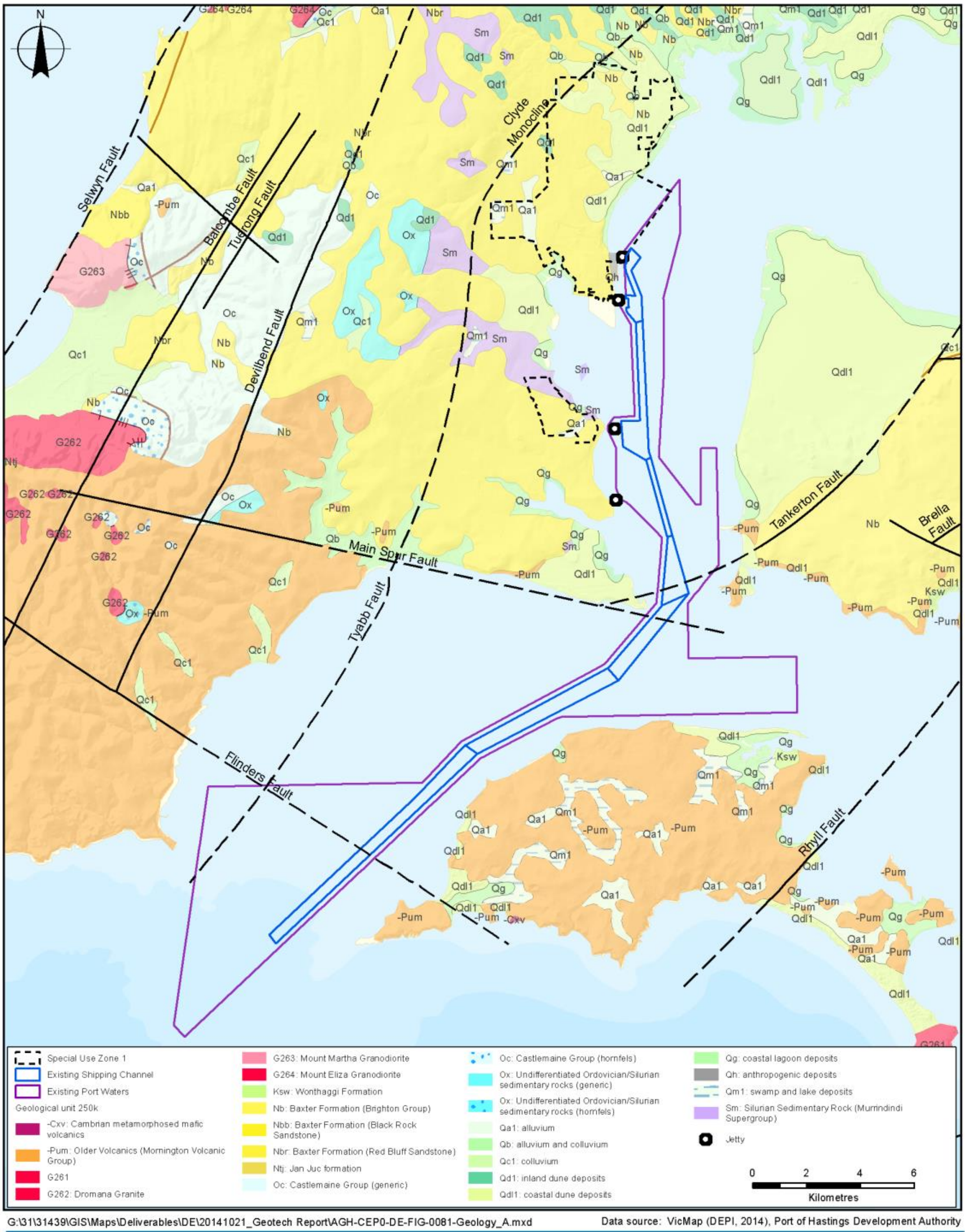


Figure 2-2. Surface Geology and Faults of Western Port

2.3.2 Generalised Stratigraphy

The stratigraphy of the western side of Western Port (which encompasses the Project site) consists of:

- Anthropogenic deposits comprising terrestrial fill, and land reclamation fill at the BlueScope Steel wharf and the Old Tyabb reclamation
- Quaternary deposits including onshore dune sands, alluvium, and swamp and lagoon sediments, and offshore soft and loose marine deposits overlying the Baxter Formation
- Baxter Formation which disconfomably overlies the Sherwood Formation and elsewhere disconformably overlies the Older Volcanics and unconformably overlies the Silurian rock.
- Sherwood Formation also overlying the Older Volcanics or the Silurian rock, and the Yallock Formation.
- Yallock Formation encountered at depth overlying the Older Volcanics and the Silurian rocks
- Older Volcanics weathered basalt present to the south of French Island and Stoney Point in the Western Channel and Anchorage
- Silurian marine sedimentary basement rock underlying the area

Quaternary dune sands comprising local thin deposits of loose to dense silty sands and sands are locally present in the terrestrial SUZ1 area. Quaternary alluvium is inferred to be locally present in terrestrial areas. Quaternary marine deposits are present at seabed comprising thin layers (generally < 1 to 4 m thick) of loose sand and very soft to firm clays and silts of low to high plasticity. Undifferentiated Quaternary, interpreted to be derived from reworking of underlying Tertiary deposits, is locally present in offshore areas which comprise similar materials to the underlying Baxter Formation but also contain shell fragments and were of lower strength.

Baxter Formation is extensively present at shallow depth across the terrestrial and marine areas of the proposed Port Area, comprising variable interbedded sands, silts and clays which are typically relatively competent. Cemented layers are present within the unit, with occasional layers of extremely low to high strength rock reported. Sherwood Formation occurs at depth across the terrestrial and marine areas and generally comprises low to intermediate plasticity silts and high plasticity clays. Cemented layers are common within this unit.

Older Volcanics are present near surface between The Nobbies and Sandy Point as a variably weathered material ranging from fresh rock to extremely weathered boulders and cobbles in a clay matrix. Highly to moderately weathered basalt rock of extremely low to very high strength was encountered in the Western Channel and gravelly clay and extremely to moderately weathered basalt of medium to high strength was encountered in the Anchorage area during the 2013/2014 investigation.

Silurian Sandstone and Siltstones are present as a variably weathered basement rock and have been encountered in the Port Area south of the BlueScope wharf at depths ranging from 22 m to 47 m below sea bed.

2.3.3 Acid Sulphate Soils (ASS)

Criteria relevant to ASS are yet to be defined. They are part of the Environmental work streams' scope.

2.3.4 Contamination

Contamination criteria are yet to be defined. They are part of the Environmental and Hydrodynamic work streams' scope.

2.3.5 Groundwater

Criteria relevant to groundwater are yet to be defined. They are part of the Environmental work streams' scope.

2.4 Metocean

2.4.1 Available Data

The Port of Hastings 2013 Description Report – Hydrodynamics Report (Reference 1) provides background information on the metocean environment and the coastal process in Western Port. Further investigations are currently being undertaken by the Hydrodynamics work stream to update, and provide further information suitable for the development of conceptual options.

2.4.2 Tidal Planes

Tides within Western Port are semi-diurnal with a strong lunar semi-diurnal component. The tidal range increases with distance from the entrance to the Western Channel, similarly to the tidal lag. The difference in tidal range between Flinders and Tooradin is approximately 0.8 m, with tidal lag about two hours between the same locations. There is a reported tidal amplification and lag within Western Port. The tidal range at Tooradin is greater than at Stony Point. There are occasions when the water level at Stony Point is lower than that at Tooradin, but none where it exceeds the value at Tooradin (Reference 10). Table 2-1 summarises the tide levels for Stony Point, however it should be noted that the historical tide records at Stony Point have not accurately recorded the high tide levels. These tidal planes will be reviewed following analysis of tidal monitoring data at Long Island Point by the Hydrodynamic workstream.

Table 2-1. Tide levels for Western Port (Stony Point) (PoMC Victorian tide tables, 2014)

Tidal level	Height (m AHD)	Height (m CD)
Highest recorded tide (06/06/88)	2.09	3.78
Highest astronomical tide (HAT)	1.72	3.31
Mean High Water Spring (MHWS)	1.15	2.84
Mean High Water Neap (MHWN)	0.70	2.39
Mean Sea Level (MSL)	0.035	1.725
Australian Height Datum	0.00	1.69
Mean Low Water Neap (MLWN)	-0.63	1.06
Mean Low Water Spring (MLWS)	-1.08	0.61
Lowest astronomical tide (LAT)	-1.69	0.00
Lowest recorded tide (27/11/03)	-1.975	-0.285

The full set of 9 tidal constants is still to be defined by the Hydrodynamic workstream.

2.4.3 Extreme Water Levels

In the absence of detailed extreme water level calculations by the Hydrodynamic team (yet to be completed at the time of writing), the parameters in Table 2-2, Table 2-3 and Table 2-4 will be adopted for the preliminary planning purposes. The parameters in Table 2-2 and Table 2-3 reflect sea level rise, storm surge and tide levels for the IPCC 2007 A1FI scenario in combination with a 'high' wind speed scenario. The storm tide figures in Table 2-3 include a joint probability assessment of climate change and surge effects.

Table 2-2: Climate change scenarios and sea level rise – Victoria (CSIRO, 2009)

	2030	2070	2100
Sea level rise (m)	0.15	0.47	0.82
Wind speed increase (%)	4	13	19

Table 2-3: Storm surge in metres and storm tide height in metres relative to MSL – Stony Point, Vic (CSIRO, 2009)

	Return Period	Current climate		2030		2070		2100	
				1	2	1	2	1	2
Storm Surge (m)	10	0.74	±0.05	0.89	0.95	1.21	1.4	1.56	1.84
	20	0.77	±0.05	0.92	0.98	1.24	1.44	1.59	1.88
	50	0.8	±0.06	0.95	1.01	1.27	1.48	1.62	1.92
	100	**0.82**	**±0.06**	**0.97**	**1.04**	**1.29**	**1.5**	**1.64**	**1.95**
Storm Tide (m to MSL)	10	1.62	±0.19	1.77	1.83	2.09	2.25	2.44	2.68
	20	1.79	±0.20	1.94	2.00	2.26	2.4	2.61	2.85
	50	1.94	±0.21	2.09	2.17	2.41	2.61	2.76	3.00
	100	**2.08**	**±0.22**	**2.23**	**2.3**	**2.55**	**2.73**	**2.9**	**3.14**

Notes:

1. Climate change scenario 1 - IPCC 2007 A1FI scenario - Hunter (2009)
2. Climate change scenario 2 - IPCC 2007 A1FI scenario in combination with 'high' wind speed scenario
3. It is noted that the Victorian Coastal Strategy 2014 (Reference 11) recommends allowance for 0.8m sea level rise by 2100.

Based on storm tide information in Table 2-3 the storm tide levels relative to Chart Datum for use in design are given in Table 2-4. In the absence of detailed wave / tide joint probability analysis by the Hydrodynamics team the 1:100 year ARI event in 2100 will be used to define platform levels, and the 1:50 year ARI event in 2100 will be used to derive wave overtopping volumes and determine seawall crest levels.

Table 2-4 Storm sea levels in metres CD based on Table 2-3

	Return Period	Current climate		2030		2070		2100	
				1	2	1	2	1	2
Storm Tide (CD)	10	3.35	±0.19	3.5	3.56	3.82	3.98	4.17	4.41
	20	3.52	±0.20	3.67	3.73	3.99	4.13	4.34	4.58
	50	3.67	±0.21	3.82	3.9	4.14	4.34	4.49	4.73
	100	3.81	±0.22	3.96	4.03	4.28	4.46	4.63	4.87

2.4.4 Winds

2.4.4.1 Normal Winds

The wind climate around Western Port has been assessed using Bureau of Meteorology (BoM) wind data from the anemometers at Rhyll and Cerberus, with some additional wind data taken from Long Island Point and the tide gauge at Stony Point (refer to Table 2-4). The data for Cerberus contained many zero values indicating calm periods and these have been removed from the wind rose to more accurately reflect the directional distribution. This data is still to be updated by the Hydrodynamic work stream.

The seasonal wind roses are presented in the Port of Hastings 2013 Description Report – Hydrodynamics Report (Reference 1).

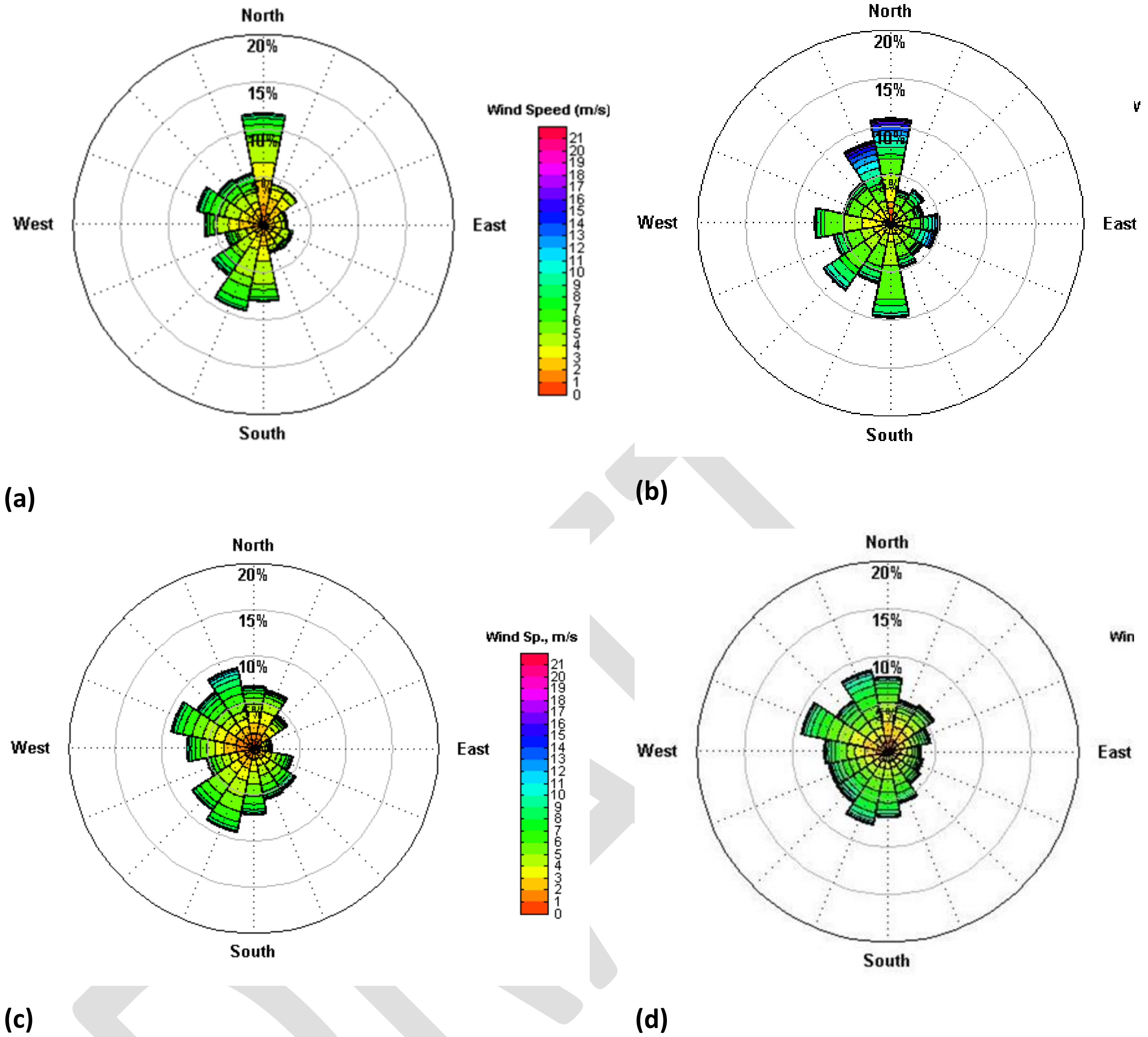


Figure 2-3. (a) Cerberus (b) Rhyll (c) Stony Point data (d) Long Island Point - wind speed (m/s) against direction 2000-2013

2.4.4.2 Extreme Winds

Extreme winds based on AS1170 Part 2 are tabulated in Table 2-5. These are based on the following:

- Annual Probability of Exceedance: 1/1000 (Design life 100yrs, Importance Level 2*)
- Regional Wind Speed: Vr = 46.5m/s (3 second gust)
- Terrain Category: 2**
- Terrain/Height Multiplier: Mz cat = 1.00 ***

a) Importance Level refers to consequence of failure as defined by AS1170.0:2002 – Structural Design Actions – General Principles. Note that AS1170 Part 2 cites more onerous design criteria for structures with special post disaster functions (Importance Level 4).

b) Terrain Category 1 refers to exposed open terrain with few or no obstructions and water surfaces at serviceability wind speeds

c) Terrain Category 2 refers to water surfaces, open terrain, grassland with few, well-scattered obstructions having heights generally from 1.5m to 10m.

d) Wind speeds have been adjusted corresponding to a structure height of 10m. Wind speeds do not incorporate any factored increase to reflect future climate change predictions.

Allowance for Terrain Category 1 wind speeds shall be made for structures in exposed areas of the terminal such as the berth and structures adjacent to open areas of land and water for normal and extreme conditions.

Table 2-5 Extreme Wind Speeds (Terrain Category 1)

Wind Direction	Site Wind Speed (3 Second Gust) m/s						
	Return Period						
	1 Year	5 Years	25 Years	100 Years	250 Years	500 Years	1000 Years
North	29.1	35.9	41.8	46.1	48.6	50.4	52.0
North East	24.8	30.6	35.5	39.2	41.3	42.8	44.2
East	23.3	28.8	33.4	36.9	38.9	40.3	41.6
South East	23.3	28.8	33.4	36.9	38.9	40.3	41.6
South	24.8	30.6	35.5	39.2	41.3	42.8	44.2
South West	26.2	32.4	37.6	41.5	43.7	45.3	46.8
West	29.1	35.9	41.8	46.1	48.6	50.4	52.0
North West	27.7	34.1	39.7	43.8	46.2	47.9	49.4

Table 2-6 Extreme Wind Speeds (Terrain Category 2)

Wind Direction	Site Wind Speed (3 Second Gust) m/s						
	Return Period						
	1 Year	5 Years	25 Years	100 Years	250 Years	500 Years	1000 Years
North	26.0	32.1	37.3	41.1	43.4	45.0	46.5
North East	22.1	27.3	31.7	35.0	36.9	38.2	39.5
East	20.8	25.7	29.8	32.9	34.7	36.0	37.2
South East	20.8	25.7	29.8	32.9	34.7	36.0	37.2
South	22.1	27.3	31.7	35.0	36.9	38.2	39.5
South West	23.4	28.9	33.6	37.0	39.1	40.5	41.8
West	26.0	32.1	37.3	41.1	43.4	45.0	46.5
North West	24.7	30.5	35.4	39.1	41.2	42.7	44.1

2.4.5 Waves

The wave climate within the port varies with the northern reaches of the existing navigation channel and turning basin exposed to primarily local wind waves and the southern section of the navigation channel exposed to both local wind waves and swell.

Initial wind wave parameters are presented in Table 2-7 where the significant wave height (Hs) is defined as the average of the highest third of waves in the wave spectrum. These have been estimated using in-house spreadsheet calculations based on the methods presented in the Shore Protection Manual and using ultimate design wind speeds in accordance with AS1170.2 - 2002 and applicable between Long Island Point and Bluescope.

Table 2-7 Estimated Significant Wave Height and Period

	Return Period		
	1 Year	100 Years	500 Years
Direction	Southerly	Southerly	Southerly
Significant Wave Height Hs (m)	1.0	1.8	2.0
Period T (s)	3.5	4.3	4.4

Additional wave information is still to be defined by the Hydrodynamic workstream however initial estimates of 1 year return period waves agree with those tabulated above.

2.4.6 Currents

Tidal currents within Western Port were modelled as part of the Western Port Receiving Water Quality Modelling (Harrison *et al*., 2007). The study found that the residual currents are strongly influenced by the braided channel and bank formations within the inner eastern estuary. The trends for a 15 day spring-neap tidal cycle are presented in Figure 2-4.

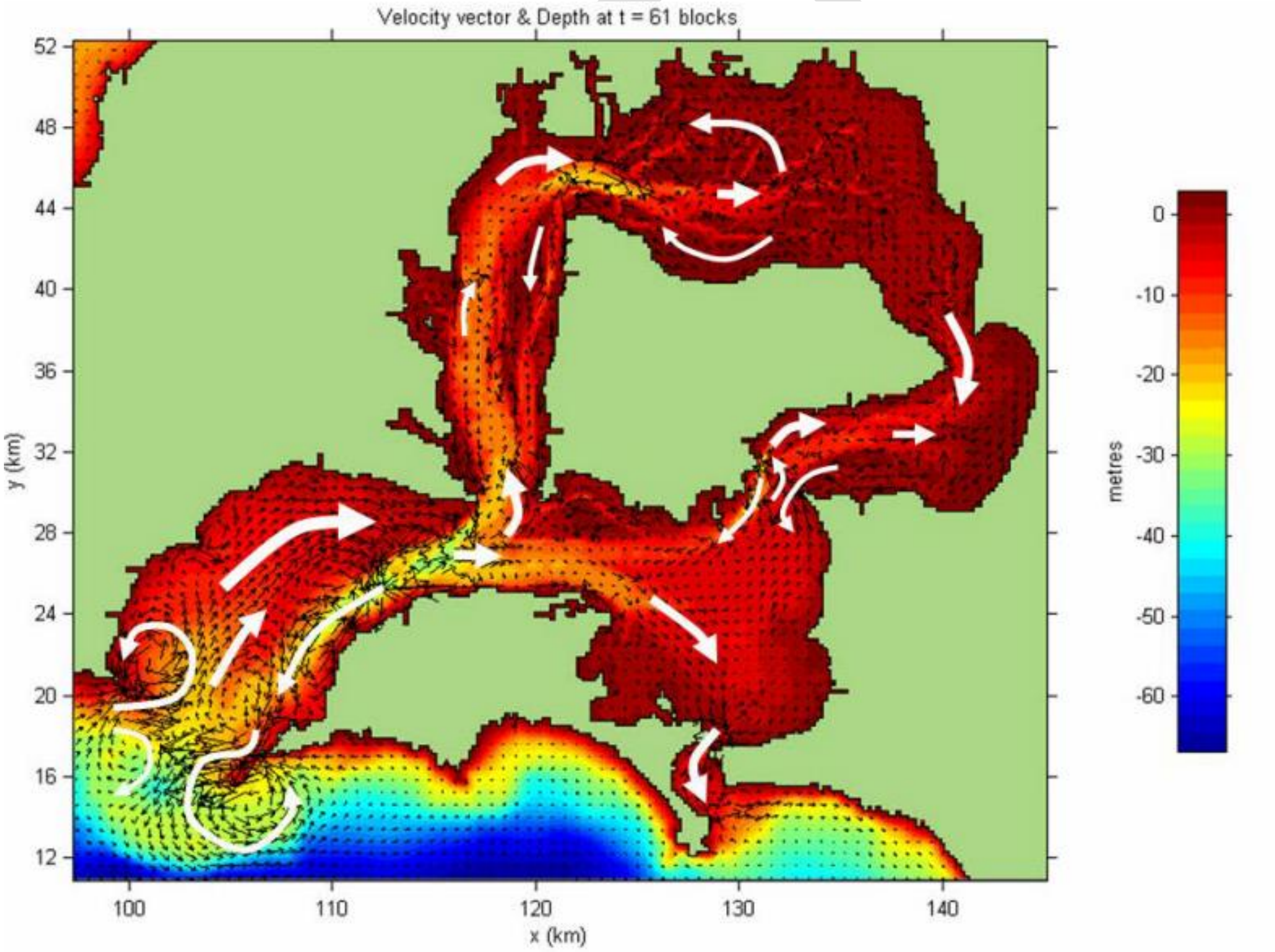


Figure 2-4. Residual velocity vectors and depth showing dominant tidal driven currents in the absence of wind (Harrison et al. 2007)

A data acquisition campaign in December 2012 (Reference 1) gathered information that has furthered the understanding of the flows in the vicinity of the proposed development. The data showed that the dominant flow direction of the northern deployed ADCP was along a NE/SW axis. The mean flow speed for the month deployment was 0.42 m/s, with a maximum of 0.85 m/s. The southern ADCP flow direction was along a N/S axis, with mean flow speeds of 0.44 m/s and a maximum of 1.0 m/s.

Figure 5. Location of the Southern and Northern ADCPs

The navigation chart for the Port of Hastings (Aus 150 “Western Port”) indicates that tidal currents in excess of 2 knots are experienced in the shipping channels immediately to the south of the Bluescope jetty area, and tidal currents in excess of 3.5 knots are experienced in the Western Channel (off Phillip Island).

Further current monitoring is being carried out in the study area to support planning, design and calibration of numerical modelling by the Hydrodynamic work stream and the above will be updated when this information is available.

2.4.7 Coastal Processes

The characteristics of sediment movement in Western Port are discussed in the Port of Hastings 2013 Description Report – Hydrodynamics Report (Reference 1).

Sand waves in the channel off Stony Point have been recorded. These are discussed in the Port of Hastings 2013 Description Report – Hydrodynamics Report (Reference 1) and further investigations are currently being undertaken by the Hydrodynamic work stream. The sand waves have previously been monitored and were found to be stable, with the tops of the sand waves being close to -14.3 m CD (Stony Point).

2.4.8 Rainfall

Criteria relevant to rainfall intensities are yet to be completed by the Hydrodynamic workstream.

2.4.9 Visibility

Criteria relevant to visibility are yet to be completed by the Hydrodynamic workstream.

2.4.10 Temperature

Extremes of shade air temperature for Coastal Region II (ie locations within 20km of the coast and South of 22.5^{o}S) and altitudes of less than 1,000m above sealevel taken from AS 5100.2 are as follows:

- Maximum = 45°C
- Minimum = -1°C

2.5 Existing Port Infrastructure

2.5.1 The Port

The Port of Hastings is an operational commercial port serving international and domestic shipping movements that include import and export of crude oil, LPG, ULP, general cargo, project cargo, ship to ship transfer, pipe laying operations and the lay-up/repair of oil rigs/floating platforms. The current port facilities do not handle containerised freight. Historically the port has been used to import steel slab but this has been discontinued. The existing port infrastructure includes berths and land in three precincts – Long Island Point, Crib Point and Stony Point. Studies completed to date have confirmed the focus of port expansion activities in the area to the north of Long Island Point and in and around the 3,000 hectares of land north of Hastings township. This area is zoned for port related uses and is referred to as the Special Use Zone (SUZ1).

Within the port environs, land is already utilised by BlueScope Steel, Esso-BHP Billiton and other land owners and tenants. The shipping channels are owned and managed by the Victorian Regional Channels Authority.

Further details are contained in the Port of Hastings 2013 Descriptive Report (Reference 3).

2.5.2 Special Use Zone

The boundaries of the SUZ 1 area (port environs) and the overall study area for the landside infrastructure are shown in Figure 2-6.

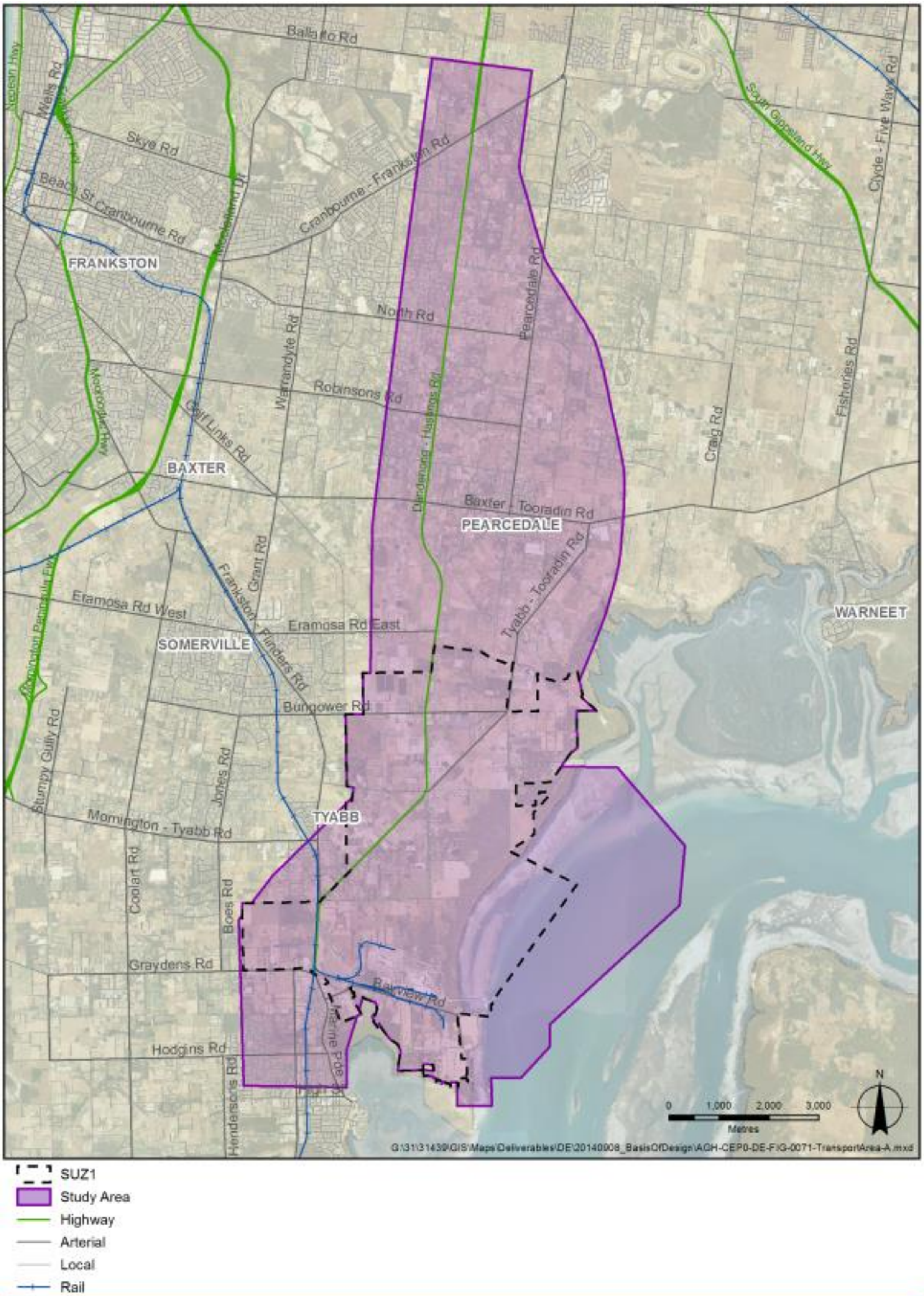


Figure 2-6. Port Environs (SUZ1) and the study area

2.5.3 Channels, Anchorages, Berth Pockets and Navigational Aids

The shipping channel to the Port of Hastings terminals consists of a two-way channel starting from the west of Phillip Island and heading in a north easterly direction to Sandy Point where it turns to the north to the existing berths. The channel has a one way capacity from north of Sandy Point to the existing berths at BlueScope. Channels, approaches, swing basin, anchorage and berth pocket details are listed in Table 2-8 and Table 2-9 and are shown in Figure 2-7.

Table 2-8 Channels, Anchorages and Swing Basins in the Port of Hastings

Channel section	Length (km)	Min. width (m)	1-Way / 2-Way	declared depth (m)[1]	Description
Primary channels					
Western Channel – South	8.0	400	2	14.8	Fairway Buoy to Buoys 7 & 8
Western Channel – Centre	6.0	400	2	14.8	Nos.7 & 8 to 13 & 14 Buoys
Western Channel – North	3.80	400	2	14.8	Nos.13 & 14 to 17 & 18 Buoys
North Arm – South	3.2	180	1	14.2	Nos.19 & 20 Buoys to Crib Point
North Arm – North	5.81	245	1	14.2	Nos.25 to 29 Buoys
Approaches and Swing Basins					
Crib Point Approach	-	-	1	12.7	24 Buoy to Crib Point Jetty
Crib Point Swing Basin	-	-	1	14.2	Adjacent to Crib Point Jetty
Long Island Point Swing Basin	-	-	1	14.2	Adjacent to Long Island Point Jetty
Steel Wharves Approach		200	1	9.0	North of Long Island Point to Steel Wharves
Steel Wharves Swing Basin	-	-		9.0	Adjacent to Steel Wharves
Anchorages					
East Arm Anchorage				10 to 20	Primary anchorage, immediately north of Cowes
Old Tyabb Anchorage				9.2	East of Old Tyabb Reclamation
Flinders Anchorage					Between Flinders and Phillip Island

Table 2-9. Existing Berth Pockets

Berth	Depth (m)	Length (m)	Width (m)
Stony Point Jetty	2.5 to 6.5	-	-
Crib Point Jetty No. 1	15.7	350	90
Long Island Point Jetty	15.7	350	90
BlueScope No.1 (Dedicated RORO berth)	12.0	290	30
BlueScope No. 2	12.0	290	30

[1] Maintained depth source = Chart AUS 150 – Western Port (Edition No. 2 dated 4 Jun 2010)

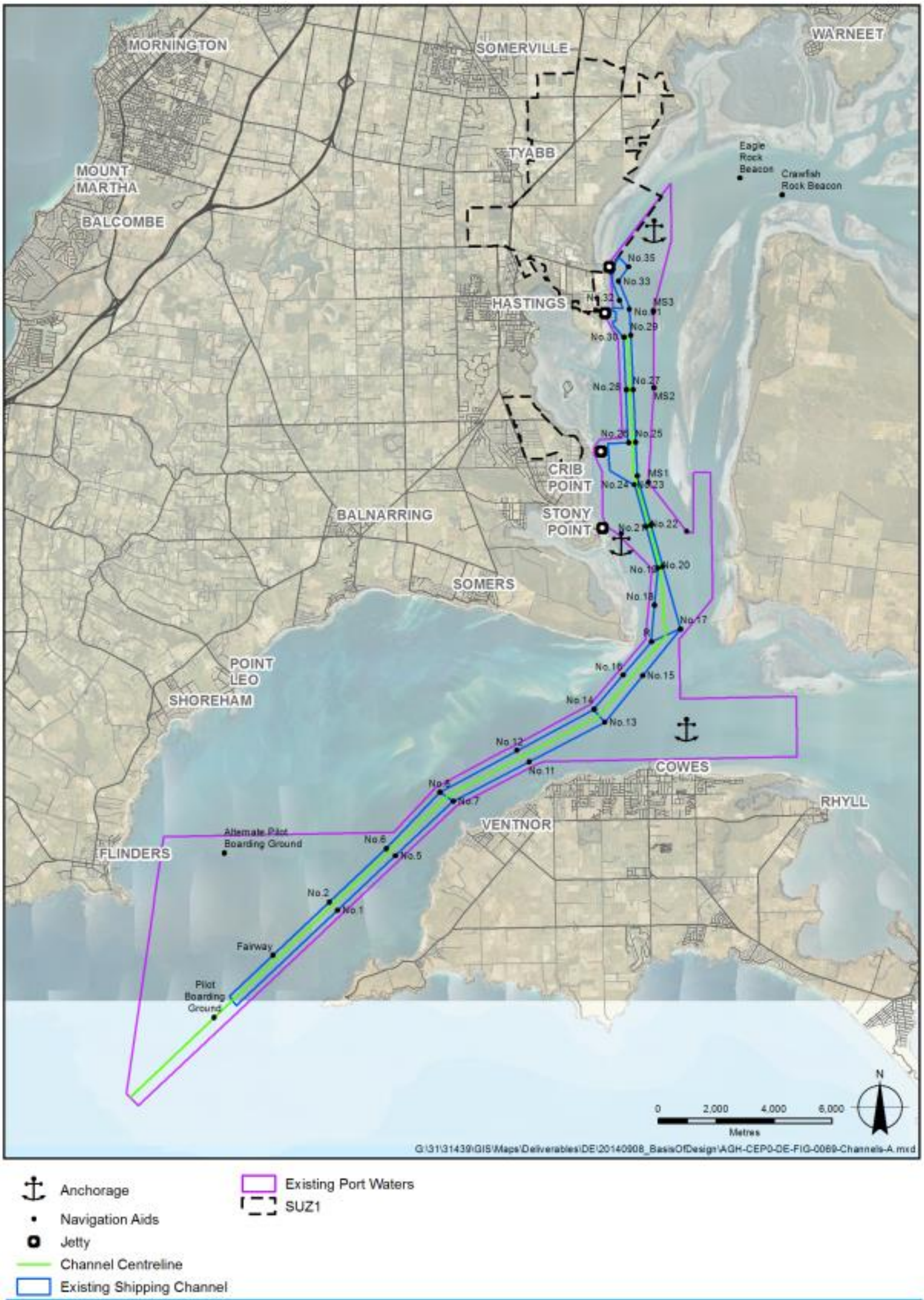


Figure 2-7. Port of Hastings Approach Channel

2.5.4 Port Terminal Infrastructure

This section summarises the terminal infrastructure at each of the existing terminals. Further information is included in the Port of Hastings 2013 Descriptive Report (Reference 3)

2.5.4.1 Long Island Point

Within the BlueScope site there are two berths owned by BlueScope Steel and operated by Patrick Western Port Stevedores. Berth 1 is a Ro-Ro berth for stern door vessels up to 16,000 DWT. Berth 2 is a conventional general cargo wharf, 152m long and suitable for vessels with a LOA of up to 190m and 50,000 DWT according to Port of Hastings Operating Handbook & Harbour Master's Directions Dec 2013.. These facilities have a declared depth alongside of 12m and a swing basin diameter of 457m and are not currently used for the steelworks facility. The northern general cargo berth is currently being used for project cargo.

Within the Esso site the Long Island Point Jetty is state owned and used by Esso and for the export of Gippsland Crude Oil and LPG. This berth can cater for a 300m LOA, 100,000 DWT tanker however according to Port of Hastings Operating Handbook & Harbour Master's Directions Dec 2013, the facility has catered for ships up to 160,000 DWT in the past. .

2.5.4.2 Crib Point

There are two berths at Crib Point. Berth 1 can cater for a 100,000 DWT, 300m LOA vessel and is used by United Petroleum for the discharge of refined petroleum fuels and automotive diesel to their terminal in Hastings. Berth 2 has been decommissioned due to its poor condition.

2.5.4.3 Stony Point

The Stony Point Jetty is currently used for the Inter Island Ferry, Seahorse Spirit Navy charter ship, and the Western Port Bay tug berth for two tug vessels. It is also used for recreational fishing. The jetty can accommodate a vessel with an LOA of up to 70m and 2 x 52t (bollard pull) tugs each 34m long.

The Stony Point depot includes the administration building which also houses harbour control. There are also several sheds and workshops within the jetty area, including a machinery shed, buoy workshop, dangerous goods store, tug office and amenities. Pollution response and buoy maintenance operations are undertaken at Stony Point.

2.5.5 Pipelines

A full list of all pipeline licences in the area, including details of operators, pipe content, length, diameter and pressure is included in the Services & Utilities report (Reference 14).

Notable pipelines located within the port area (refer to Figure 2-8), include:

- Western Port-Altona-Geelong (WAG) Pipeline, used to transfer gas to refineries in Geelong and Altona
- ESSO Australia pipeline for the transfer of gas from Longford to Long Island
- Elgas and Vic Gas pipelines for Liquid Petroleum Gas (LPG) for local use
- Crude Oil pipeline from Longford to Long Island Point owned by Esso Australia and BHP Billiton
- United Petroleum Pty Ltd pipeline for unleaded petrol from Crib Point to storage facility at Long Island Point.

In addition to the gas and oil pipelines, there are also the following services easements in the area:

- Water Pipeline – Melbourne Water
- High Voltage Transmission Line – United Energy

2.5.6 Utilities

Details of major local utilities and services are documented in the Services & Utilities report (Reference 14).

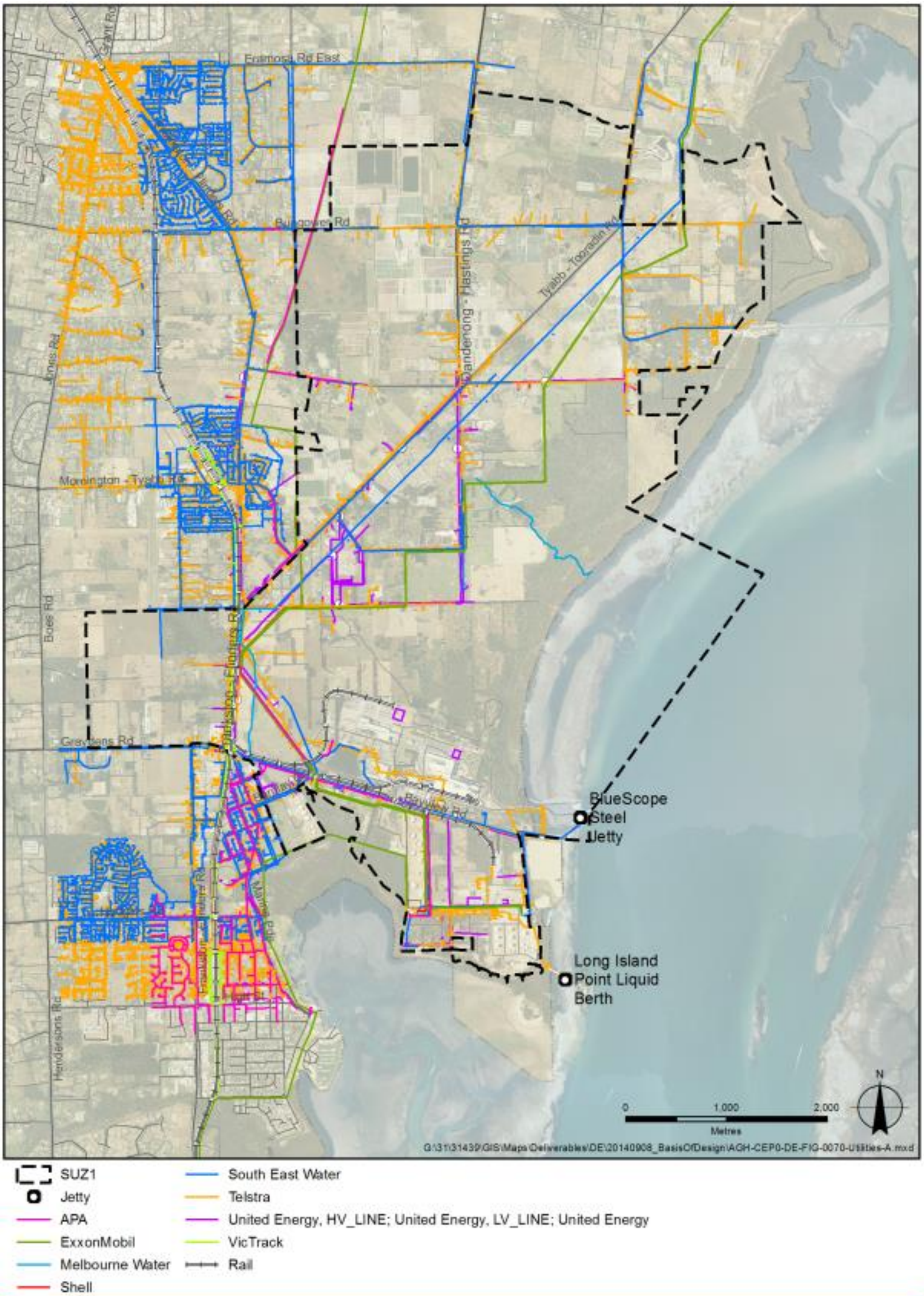


Figure 2-8. Plan of existing utilities around the Port of Hastings

2.5.7 Drainage Networks

The Long Island Point precinct is relatively flat and has existing, predominantly man made, drainage infrastructure in place to cater for stormwater runoff.

A review of relevant data indicates that all of the major roads surrounding the site have swales or channels running alongside them, with culverts crossing under roads in appropriate locations. There are two major outlets to Western Port:

- to the north side of the existing Old Tyabb Reclamation at the end of Bayview Road, and
- to the south end of the Old Tyabb Reclamation near the end of Long Island Drive.

Further details on surface water catchments and their management are documented in the Services & Utilities report (Reference 14).

2.5.8 Transport Networks

Access to the Western Port area is provided by major highways and a broad gauge railway. There are four broad access routes between Melbourne and Western Port. On the Mornington Peninsula side, Peninsula Link and Western Port Highway provide access, including the major strategic access routes to the Port of Hastings. On the northern and eastern coast, the South Gippsland Highway and the Monash Freeway – Healesville-Koo Wee Rup road routes provide strategic access.

Rail access is provided by a single-track broad gauge railway that operates as an extension of the double-track electrified suburban Frankston line. This line serves multiple purposes including an intensive suburban commuter railway, a low-frequency passenger service between Frankston and Stony Point, and established freight movements to and from the steelworks at Long Island. A disused railway corridor exists through Tooradin and Koo Wee Rup on the northern coastline of Western Port; it is currently being converted to a rail trail by removing the disused rail infrastructure.

Further details are provided in the Port of Hastings 2013 Descriptive Report (Reference 3) and on the Port of Hastings WebMap (https://projectmap.ghd.com/pohda/).

3.0 Planning Parameters and Operational Criteria

3.1 Vessel Navigation and Marine Operations

3.1.1 Design Vessels

Background and details relating to forecast vessels are contained in the Commercial and Economic work stream (Reference 9) report.

3.1.1.1 Container Vessels

Table 3-1 outlines the characteristics of the design container vessels expected to call at the Port of Hastings. The following vessel sizes are preliminary only and are based on initial output from studies undertaken by the Commercial and Economic workstream which are ongoing and subject to future change.

Table 3-1. Container Vessel Characteristics

Characteristic	Unit	Minimum Vessel	Design Vessel (Stage 1)	Maximum Design Vessel
Design Ship Capacity	TEUs	777	8,000 – 10,000	18,000 – 19,200
Dead Weight Tonnage (DWT)	tonnes	12,600	93,600	195,000
Displacement Tonnage	tonnes	17,200	135,600	249,000
Length Overall (LOA)	m	144	300	400
Length Between Perpendiculars (LBP)	m	135	286	376
Beam (B)	m	22.6	42.8	59
Depth (D)	m	10.8	24.6	30.3
Maximum Design Draught (T_{Design})	m	8	14.5	16
Air Draught (Ha)	m			
Transverse (i.e. y-axis) metacentric height of the ship (GM)	m			
Longitudinal (i.e. x-axis) centre of metacentric height	m			
Bow Radius	m			
Bow Flare Angle	degrees			
Main Engine – Power	kW	n/a		
Main Engine – Propeller Diameter	M	n/a		
Main Engine – % of total power utilised whist at berth	%	n/a		
Bow Thruster – Power	kW	n/a		
Bow Thruster – Propeller Diameter	%	n/a		
Bow Thruster – % of total power utilised whist at berth	m	n/a		

Note: Shaded areas are to be defined prior to Preliminary Design

3.1.1.2 *Tankers*

Table 3-2 outlines the characteristics of the maximum tanker vessels that currently call at the Port of Hastings and the possible future maximum vessel that could call at the Port of Hastings during the forecast period (Reference 12). It is noted that growth in vessel size is allowed for petroleum product tankers only. It is noted that these ship sizes could change following industry discussion with Hastings importers and exporters.

Table 3-2. Tanker Characteristics

Vessel	Deadweight Tonnage - DWT (tonnes)	LOA (m)	Beam (m)	Draught (m)
Crude oil tankers				
• Current Maximum	115,000	250	44	15.5
• Possible Future Maximum	115,000	250	44	15.5
LPG tankers				
• Current Maximum	58,000	230	37	12.6
• Possible Future Maximum	58,000	230	37	12.6
Petroleum products tankers				
• Current Maximum	45,000	187	32	12.2
• Possible Future Maximum	72,000	227	32	13.9

3.1.1.3 *Other Vessels*

Table 3-3 outlines the characteristics of other vessels that will potentially use the port. The tabulated ship sizes could change following industry discussion with relevant operators and stakeholders. Details of ongoing operations at the Bluescope general cargo berth are to be confirmed for incorporation in the planned facilities.

Table 3-3. Other Vessel Characteristics

Characteristic	Unit	Tugs[1]	Bunker Vessels	Offshore Supply Vessels	Project Cargo Vessels	Bass Strait RORO Vessels[2]
Dead Weight Tonnage (DWT)	tonnes	n/a				11,000
Displacement Tonnage	tonnes					14,127
Length Overall (LOA)	m	35				184.4
Beam (B)	m	12				23.64
Full-Load Draught (T_{FL})	m	4.8				6.35
Length Between Perpendiculars (LBP)	m	n/a				172.37
Bow Radius	m	n/a				
Bow Flare Angle	degrees	n/a				
Twin or Single Screw Vessel						
Main Engine – Power	kW					
Main Engine – Propeller Diameter	M					
Main Engine – % of total power	%	100				

Characteristic	Unit	Tugs[1]	Bunker Vessels	Offshore Supply Vessels	Project Cargo Vessels	Bass Strait RORO Vessels[2]
utilised whist at berth						
Bow Thruster – Power	kW	n/a				
Bow Thruster – Propeller Diameter	%	n/a				
Bow Thruster – % of total power utilised whist at berth	m	n/a				

Notes

1. Based on a nominal tug pull of 68tonnes.
2. Based on the Victorian Reliance and Tasmanian Achiever that are currently used by Toll Transports at Webb Dock 1 East
3. Shaded areas are to be defined prior to Preliminary Design

3.1.2 Vessel Operations

This section outlines preliminary vessel operational criteria in the Port of Hastings. This will be further refined following completion of the 2D vessel simulation modelling and review with the Harbour Master and Port Phillip Sea Pilots.

3.1.2.1 Vessel Transit Speeds

Initial estimates have been made of vessel transit speeds. Table 3-4 outlines the transit speeds through the various channel sections from the pilot boarding ground at the Port Limits to either the Crib Point Jetty Swing or Long Island Point. Figure 3-1, Figure 3-2 and Figure 3-3 outline the speed envelopes through the channel for various vessel types and directions. The chainage has been defined based on the centreline of the existing channel from the Port Limits at the pilot boarding ground.

These transit speeds are provisionally agreed with the Harbour Master and the Port Phillip Sea Pilots, and are to be confirmed during full bridge navigation simulation studies.

Table 3-4. Speed Envelopes (Knots)

Vessel	Pilot Boarding Ground	Western Channel In	North Arm In	Swing Basin	North Arm Out	Western Channel Out
Container Vessels	12	16	12	6	12	16
Crude oil tankers and LPG tankers	12	12-14	10	6	8-10	10-12
Petroleum products tankers	12	14-16	12	6	12	14-16

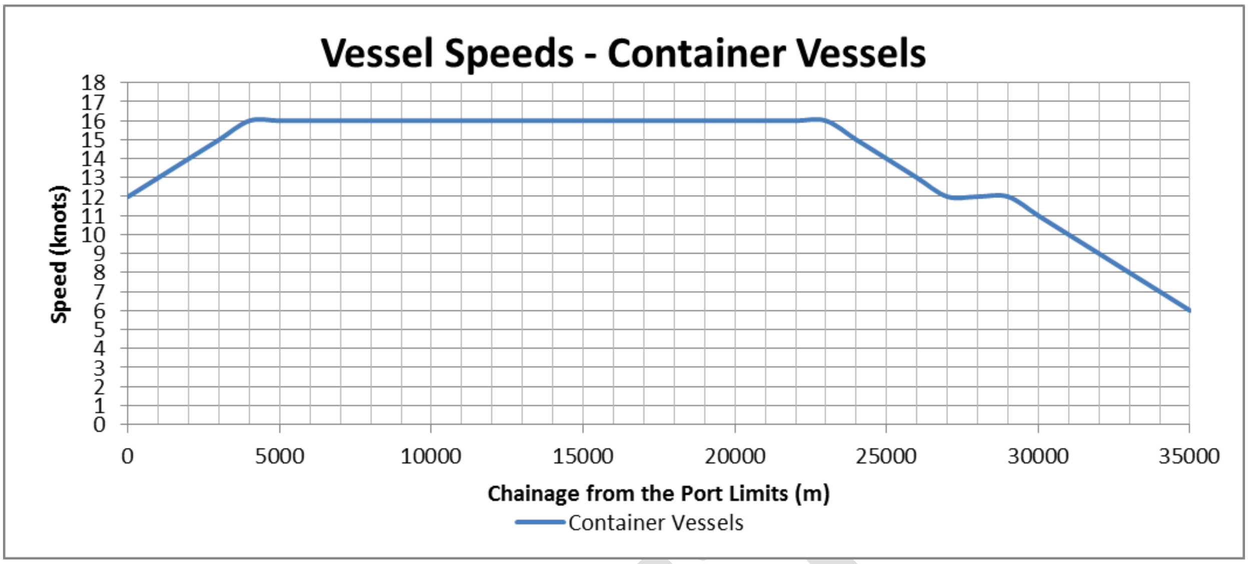


Figure 3-1. Speed Envelopes for Container Vessels

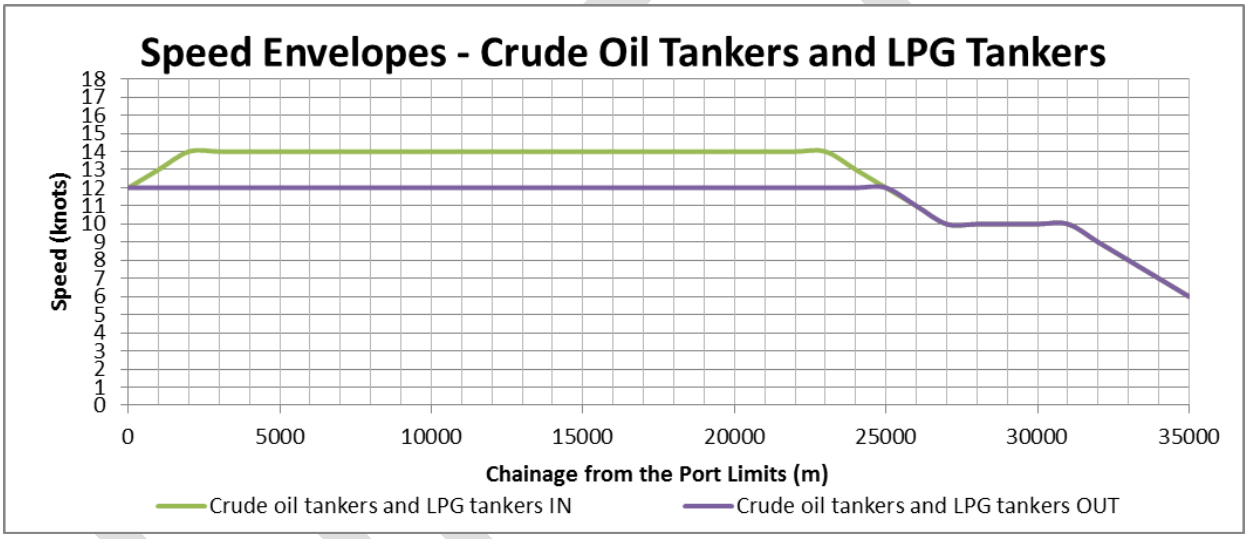


Figure 3-2. Speed Envelopes for Crude Oil Tankers and LPG Tankers

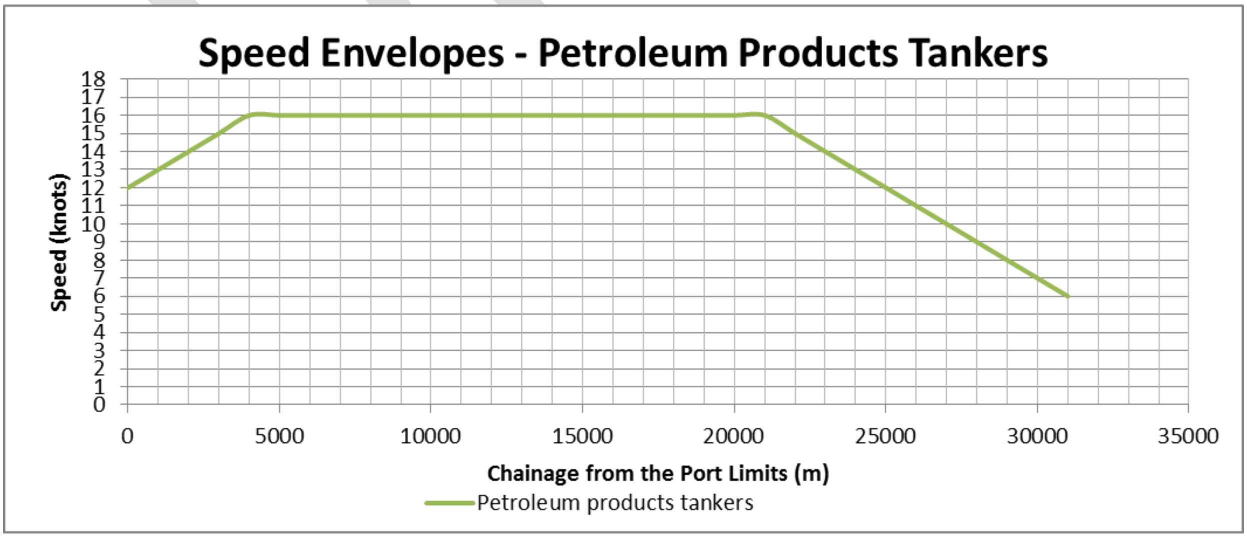


Figure 3-3. Speed Envelopes for Petroleum Products Tankers

3.1.2.2 Arrival and Departure Draughts

The actual arrival and departure draughts are expected to be less than scantling draughts. An assessment of actual sailing draughts is currently being undertaken by the Commercial and Economic workstream to further inform the channel design, (Reference 13). At the time of writing, the findings of this study have not been published.

3.1.2.3 Pilotage

Pilotage is compulsory for all commercial vessels except for some Bass Strait service vessels which may obtain Harbourmaster exemptions.

The pilot boarding ground is assumed to remain at the current location which is approximately 3.5 NM south of West Head at the western entrance to Western Port. As per the current operations vessels will embark their pilot at the outer pilot boarding ground, in position approximate 38º 32.7' S, 145º 01.8' E.

3.1.2.4 Tug Assistance

According to the Port of Hastings Operating Handbook & Harbour Master's Directions Dec 2013 there are currently no prescribed requirements or criteria for the use of tugs in Western Port and tug assistance requirements are determined by Owners, Masters and Pilots in consultation with the Harbour Master. Tug requirements for the expanded port will be determined in consultation with the Harbour Master and the Port Philip Sea Pilots and confirmed in full bridge navigation simulations.

Initial assessment is that as a minimum two tugs will be required to assist with the berthing and unberthing of the design vessel in normal circumstances. The tugs will be required to have a 68 tonne bollard pull (minimum) which covers all normal operating parameters. The design containerships which are expected to have ships' own manoeuvring systems (ie bow and stern thrusters), will provide a safety margin in marginal conditions.

The tugs will join inbound container vessels between number 27 and 31 beacons and will secure once the speed has reduced to 6kts as the vessel has entered the swing basin. Outward bound, the tugs will be released in the vicinity of number 27 beacon.

It is assumed that escort towage will need to be provided for both inward and outward transits of the design vessels.

Currently there are no criteria or prescribed requirements for the use of tugs in the Port of Hastings, however adverse weather forecasts, storm surges or other exceptional circumstances may cause the Harbour Master to require a "standby tug" to be made available while a vessel is in port. For the purpose of the Concept Design it has been assumed that future port operations will require vessels to use tugs.

3.1.2.5 Vessel Traffic Service

The future port will need to have Vessel Traffic Service (VTS) for control of vessel movements. This VTS will operate as part of the Harbour Master's department and the Australian Maritime Safety Authority (AMSA).

3.1.3 Navigational Channels

3.1.3.1 Channel Design Parameters

The navigational channels are to be designed in accordance with PIANC Harbour Approach Channels Design Guidelines – 2014. The design will be confirmed by the use of 2D modelling and full bridge simulation in subsequent stages of the study. The navigation simulation program will be designed to demonstrate navigational safety while minimising the extent of dredging required.

Navigation aids are to be designed in accordance with relevant IALA Recommendations and Guidelines.

In line with recommendations of PIANC WG 121-2014 guidelines, the channel will be aligned to ensure that the channel toe lines do not come within 120 metres (2 x vessel Beam) of any tanker terminal berth pocket or vessel at a tanker terminal.

3.1.3.2 Channel Navigation Aids

The channel will be marked by paired lit buoys with radar reflectors and AIS transponders at a spacing and visibility defined by the IALA regulations. Leading marks may be provided where appropriate. This corresponds to an 'Aids to Navigation' rating of "good" according to the PIANC Harbour Approach Channel Design Guidelines 2014. The navigational aid provision will be tested and verified during full bridge navigation simulation.

3.1.3.3 Conceptual Dimensions

The conceptual dimensions for the anchorage, vessel approaches, swing basin and berth pockets will be based on the PIANC guidelines and will be confirmed through 2D simulation and in liaison with the Port Philip Sea Pilots and Harbour Master.

For conceptual planning of the berth pockets, it is considered reasonable to assume an inter-vessel spacing equal to the beam of the vessel. The vessel is assumed to be berthed bow-out for operational and safety reasons following consultation with Sea Pilots and Harbour Master.

3.2 Container Terminal

3.2.1 Cargo Types and Trade Forecast

3.2.1.1 Container Dimensions

ISO containers are recognised in terms of Twenty Foot Equivalent Units (TEU). Container details are presented in the below table.

Table 3-5. Container Details

	20'	40'	45'	Out of Gauge (OOG)
Length	6.096 m	12.192 m	13.716 m	Limited only by shipping lines
Width	2.438 m	2.438 m	2.438 m	Limited only by shipping lines
Height	2.591 m	2.591 m /2.896 m	2.896 m	Limited only by shipping lines
Weight empty	2,330 kg/2,400 kg	4,000 kg/ 4,300 kg	4,800 kg	Limited only by shipping lines
Weight full	24,000 kg/30,480 kg	30,480 kg	30,480 kg	Limited only by shipping lines
Payload	21,670 kg/28,080 kg	26,480 kg / 26,180 kg	25,680 kg	Limited only by shipping lines

3.2.1.2 Trade Forecast

Refer to the report prepared by the Commercial and Economic workstream (Reference 9)

3.2.1.3 20/40 Ratio

Refer to the report prepared by the Commercial and Economic workstream (Reference 9).

3.2.1.4 Modal Split

Refer to the report prepared by the Commercial and Economic workstream (Reference 9). Sensitivity testing will be undertaken to consider the requirements for a maximum share of 30% to rail.

3.2.1.5 Dwell Times by Mode

Refer to the report prepared by the Commercial and Economic workstream (Reference 9).

3.2.1.6 Vessel Call Spectrum

This is documented in the report prepared by the Commercial and Economic workstream (Reference 9)

3.2.2 Planning Parameters

3.2.2.1 Berth Performance Indicator

The proposed berth throughput targets are as outlined in Table 3-6. These estimates are preliminary and subject to change based on output from terminal capacity/operations assessments.

Table 3-6. KPI by Time Period

Timing	TEU/m
2020 - 2028	1,200 – 1,300
2029 - 2034	1,300 – 1,500
2035 - 2040	1,500 – 1,800
Beyond 2040	>2,100

3.2.2.2 Berth Utilisation

Targeted "not to exceed" berth utilisation shall be in line with published criteria to reflect random arrivals and to ensure a service to waiting ratio of less than 10%. The adopted parameters are shown in the following table. These estimates are preliminary and subject to change based on output from terminal capacity/operations assessments.

Table 3-7. Berth Utilisation

No. of Berths	Target Occupancy Rate
1	35%
2	50%
3 and more	65%

3.2.2.3 Container Terminal Operating Parameters

Design criteria and parameters related to the operational performance of the container terminal are defined in the Terminal Systems Static Modelling Report (AGH-CEP0-DE-REP-0021). This documents parameters for:

- Crane Rates and Intensity
- Yard Operational Modes and Performance indicators
- Gate Operations
- Truck Turnaround Times
- Terminal Equipment
- Maintenance Facilities – (noting that a provisional building footprint of 120m x 30m will be provided per 4M TEU capacity terminal)
- Facilities for leaking containers, container isolation, out-of-gauge containers. reefer racks
- IT Systems

3.2.2.4 Operating Hours/ Downtime

Terminal operating hours are assumed to be 365 days per year, 24 hours per day.

Downtime is to be assessed based on the wind data in Section 2.4.4.1 and the limitations of the cranes and where relevant, vessel movements at berth arising from wave action.

3.2.2.5 Terminal Offices, Mess, Ablutions

The estimate for the numbers of staff and their functions is not yet confirmed. This will be undertaken as part of the C&E work stream financial modelling activities.

The terminal planning shall however, include provision for terminal office buildings, canteen and amenities.

3.2.2.6 Security Systems and ISPS Boundaries

ISPS boundaries are to be defined in coordination with the State Authorities. Boundary conditions are to comply with ISPS regulations. To be updated progressively based on output from terminal capacity/operations assessments.

3.3 Other Terminals

3.3.1 Bass Strait Trade

Details of vessels servicing other precincts are documented in section 3.1.1.2

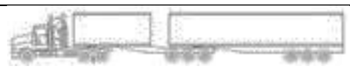
3.4 Road and Rail Infrastructure

3.4.1 Roads

3.4.1.1 Truck Fleet Profile

The types of vehicles to be accommodated at the Port of Hastings are presented in Table 3-8:

Table 3-8: Vehicle Fleet likely to serve Hastings

Vehicle	TEU Capacity	Vehicle Length[1]	Turning Circle[2]	Schematic of Vehicle
Semi-Trailer	2	19 m	26 m	
B-Double	3	26 m	26 m	
Super B-Double	4	36 m	31 m	
Super B-Triples	6	53 m	31 m	

Notes:

1. Source Austroads
2. Turning circles are diameters and are based on a speed of 10km/hr, source Auto Turn V8.2

The subsequent summary preliminary parameters considered for planning are presented in Table 3-9.

Table 3-9: Summary Vehicle Parameters

Factor	Parameter	Value
Truck Capacity	Semi-trailer	2 TEU
	B-Double	3 TEU
	Super B-Double	4 TEU
	Super B-Triples	6 TEU
Truck Utilisation[1]	Semi-trailer	50% (1 TEU average loading)
	B-Double	65% (2 TEU average loading)

Factor	Parameter	Value
	Super B-Double	75% (3 TEU average loading)
	Super B-Triples	No data available
Design Speed	Design Speed	Dependent of road transport connection scenario adopted
General Mass Limit Vehicles	Semi-trailer	42.5t
	B-Double	62.5t (max axle load 22.5t)
	Super B-Double	Up to 77.0 tonnes subject to axle configuration (max axle load 22.5t)
	Super B-Triples	Up to 77.0 tonnes subject to axle configuration (max axle load 22.5t)
Higher Mass Limit Vehicles	Semi-trailer	45.5t (max axle load 22.5t)
	B-Double	68.0t (max axle load 22.5t)
	Super B-Double	Based on 77.0 tonnes subject to axle configuration
	Super B-Triples	Based on 77.0 tonnes subject to axle configuration
Design Vehicle	Design Vehicle	30m Super B-Double (HPFV) (max axle load 22.5t)

Notes:

1. Based on that currently experienced through the Port of Melbourne and utilised for the Department of Transport's Metropolitan Intermodal System study

3.4.2 Rail

The Concept of rail operations will be determined by studies being undertaken by the Commercial & Economic work stream. These studies are not currently complete.

3.4.2.1 Rail Corridor Capacity

For the purposes of early stage project planning it is assumed that any future rail corridor will have sufficient capacity for the mode share being considered.

3.4.2.2 Grade Separation

Current government policy specifies no new 'at grade' level crossing in Victoria, and it is considered unlikely that this policy will change in the future. As such, it is appropriate to assume that all intersections of public road and rail will be grade separated for this project. Within the terminals the requirement for grade separation will be evaluated for each case.

3.4.2.3 Rail Design Consist

The Department of Transport is developing concepts for a Metropolitan Intermodal System (MIS) to transfer containers around metropolitan Melbourne. In this context it is appropriate for the rail design consist for the Port of Hastings to be consistent with the concept of operations for the MIS, with capacity for locomotive "run arounds" should these be required.

Trains would typically be of 590 m in length with an indicative 42 vehicles and a two locomotive push/pull configuration. The longer term growth of the MIS system envisages that trains within this system may grow to 900 m in length with two locomotives in push /pull configuration and this configuration also needs to be catered for within the port terminal. In addition to the MIS system, trains from regional areas and interstate will deliver export containers to the port. These trains are currently 1200 to 1500m in length and design capacity should allow for up to 1800m for the future. Trains in excess of 900 m will arrive at the marshalling terminal (north of the port) and be broken down to a maximum length of 900 m for travel to and unloading at the port terminal. "Run around" capability will be required for these trains.

Key criteria for the rail design consist are summarised in Table 3-10.

Table 3-10. Rail Design Consist Criteria

Parameter	Criteria
Minimum train length	600m
Maximum train length (network and marshalling terminal)	1800m
Maximum train length (port terminal)	900m
Minimum horizontal curve radius	250m

3.4.2.4 Rail Container Stacking

Limits on the double stacking of containers on trains are present across Melbourne and at Federation Square, an essential point to pass from all points west of Melbourne CBD. Accordingly it is assumed that single stacking of trains will be the normal operation for trains travelling to the Port of Hastings. The bridges planned in the Westernport Highway are designed with deeper foundations allowing for the track to be lowered if required. All bridges within the port environs, port precinct and the port terminal are to be designed with deeper foundations allowing for the track to be lowered if required.

3.4.2.5 Train Marshalling Terminal

A train marshalling terminal will be provided adjacent to the port to break longer trains into the correct configuration for the port terminal and make up trains for their journey away from the port.

In the absence of the completion of the 'Concept of Rail Operations' study, the marshalling terminal will provide arrival and departure facilities for trains up to 1800 m length together with a staging facility for MIS or 900 m trains.

The train marshalling terminal will also include:

- Wagon repair services
- Locomotive servicing and provisioning including fuelling facilities
- Train storage/layover facilities where trains do not depart immediately
- Train crew facilities for crew change

3.5 Port Services

3.5.1 Port Administration

The detailed requirements will be defined as part of the ongoing master planning in consultation with the commercial and economic workstream, PoHDA and relevant regulatory authorities.

3.5.2 Harbourmaster

Assumed that facilities will be off port and requirements defined in consultation with the commercial and economic workstream and PoHDA.

3.5.3 Pilot

Pilotage services may be provided by the Port Phillip Sea Pilots or a different entity. The facility requirements will be defined as part of master planning in consultation with C&E and PoHDA.

3.5.4 Line Boats

Small craft berth facilities for mooring line boats will be considered.

3.5.5 Tugs

As required to service vessels. This will be based on the results of the channel simulation.

3.5.6 Security

Security provision shall be as per the requirements of the Maritime Transport Security Act 2003 and from the findings of appropriate risk assessment, that are not yet completed.

3.5.7 Customs

Still to be defined and subject to the outcomes of regulatory authority consultation.

3.5.8 Quarantine

Still to be defined and subject to the outcomes of regulatory authority consultation

3.5.9 Pollution Control Services

Still to be defined and subject to the outcomes of regulatory authority consultation. A designated area for the storage of leaking or damaged containers shall be included.

3.5.10 Vessel Servicing and Repair

Still to be defined and subject to the outcomes of regulatory authority consultation

3.5.11 Survey / Maintenance

Facilities are to be provided for a survey vessel and maintenance operations.

The facilities are to be suitable for use by the Authority or if subcontracted to a private company.

3.5.12 Fire Services and Emergency Response

The detailed requirements are yet to be defined. These are subject to the outcomes of regulatory authority consultation.

3.5.13 Bunkering

Barge bunkering for refined fuels and LPG are to be considered

3.6 Port Precinct

The functional needs of the port precinct are subject to the outcomes of the Port Industry Needs Analysis studies being undertaken by the C&E work stream. In the absence of the study outcomes, appropriate benchmark provisions will be adopted. The benchmark provisions currently in place are documented in the Port Precinct & Environs Preliminary Planning Concepts Report (AGH-CEP0-DE-REP-0011).

3.6.1 Empty Container Facilities (ECF)

The requirements and operational criteria relevant to empty container facilities are still to be defined, but will be assumed to include the following for the purposes of planning:

- ECF's will organised and integrated with the container terminal
- Volumes, lead and dwell times are defined in the C&E forecasts
- Services provided will include repair, pre-tripping and washing facilities
- Environmental management requirements that are similar to existing facilities in Victoria

3.6.2 Port User Facilities

The scope of port user facilities to be provided is yet to be defined.

3.7 Port Environs

Ports have special land use planning requirements that need to be identified and protected to reflect their role and contribution to Victoria's economy.

Primary land use planning considerations are most appropriately addressed early on at the 'strategic planning' stage rather than at the planning permit or implementation stage.

To guide and inform the initial port option design and development process for the Port of Hastings, the following strategic land use planning principles have been prepared as a general suite of expectations or parameters.

1. Alignment with Government Policies and Strategies

Consistency with relevant National, State and Local land use and transport planning policy including:

- Our Cities, Our Future –A National Urban Policy for a Productive, Liveable Future
- National Land Freight Strategy Update, June 2012
- National Ports Strategy, July 2012
- Metropolitan Planning Strategy: 'Plan Melbourne', 2013
- Growing Freight on Rail and Transport Solutions
- Victorian Freight & Logistics Plan (VFLP) discussion paper
- Victorian Planning Scheme / Mornington Peninsula Planning Scheme.

2. Provision of an Integrated, Whole of Port Planning Solution

Land use allocation and layout at the Port of Hastings will have a direct connection or linkage with future port operational efficiency and effectiveness. Key integrated port planning principles include:

- Plan for land use outcomes consistent with the purposes of the Port of Hastings having regard to primary (core precinct), secondary (broader precinct) and interface locations
- Future proof long term development by ensuring that sufficient land is available for port expansion. To maximise opportunity for new trades arising from the existing port precincts layout, configuration and nature of existing use
- Plan and protect the long term development of both road and rail transport modes to and within the port
- Identify and protect areas of significant environmental and/or cultural value (refer Table 3-11)
- Plan for integrated utility or services corridors
- Ensure that the combination and location of core port uses appropriately addresses amenity, risk and residual emissions.

3. Managing the Port Interface

Managing the interface between port and freight activity and other near port land uses is an important planning (and design) consideration. The overarching interface management principle is to minimise future conflicts between land uses to ensure the ongoing, efficient and safe operation of the port. Key principles include:

- Separation of potentially conflicting industry types and transport systems
- Co-location of amenity-affecting land uses that require a substantial threshold distance
- Minimising the disruption and impacts on existing port precincts, considering their layout, configuration and nature of existing use

4. Address potential adverse environment, social and economic effects and impacts

At a high level, consideration will be given to managing potential adverse effects and impacts. The port option design and development process for the Port of Hastings should seek to manage the impact on areas and sites with significant environmental, historic, architectural, aesthetic, scientific and cultural values.

The following table outlines specific considerations for the port design and development process that are reflected in planning policy and/or controls within the Mornington Peninsula Planning Scheme:

Table 3-11. **Option development considerations arising from planning policy**

Considerations	Description
Affected parcels	Identify the number and nature of affected properties
Impact on Existing Businesses	Disruption to existing businesses during construction/operation
Severance Issues	Physical access to properties and community facilities, impacts on road, public transport, walking and cycling networks
Amenity	Proximity to residential areas, open space and other sensitive land uses. consider the number of residential lots, open space sites and sensitive land uses within 100 m, 200 m and 500 m of the site option
Heritage Impact(s)	Proximity to and potential impact on aboriginal and non-aboriginal cultural heritage sites
Flora and Fauna Impact(s)	Proximity to and potential impact on listed flora and fauna species/communities
Surface Water Impact(s)	Proximity to and potential impact on surface and groundwater, land subject to inundation and flood zones

4.0 Engineering Design Criteria

4.1 General Requirements

4.1.1 Design Standards, Codes & Guidance

General guiding principles for durability, future proofing, SID etc for planning and engineering are covered in Section 1.3. This section is specific to engineering design.

Concept and preliminary planning and design shall take into consideration the design recommendations and guidelines of the relevant Australian and international codes of practice and guidelines appropriate to the level of detail of the design including:

Table 4-1. Standards, Codes and Guidance

REFERENCE	TITLE
AS/NZS 1163	Cold-formed structural steel hollow sections
AS/NZS 1170.0	Structural design actions—General principles
AS/NZS 1170.1	Structural design actions—Permanent, imposed and other actions
AS/NZS 1170.2	Structural design actions—Wind actions
AS/NZS 1170.4	Structural design actions—Earthquake action
AS/NZS 1554	Structural steel welding
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1720	Timber structures
AS 2159	Piling - Design and installation
AS/NZS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2419.1	Fire hydrant installation—System design
AS 2832 parts 3 & 5	Cathodic protection of metals
AS 3600	Concrete structures
AS 3678	Structural steel - Hot rolled plates, floorplates and slabs
AS 3679	Structural steel - Hot rolled bars and sections
AS/NZS 3725	Design for installation of buried concrete pipes
AS 3990	Mechanical equipment - Steelwork
AS 3996	Access covers and grates
AS 4100	Steel structures
AS/NZS 4671	Steel reinforcing materials
AS 4678	Earth-retaining structures
AS 4997	Guidelines for the design of maritime structures
AS 5100	Bridge design
BS 6349	BS6349 Marine Structure Part 1 – 2000: Code of Practice for General Criteria

REFERENCE	TITLE
BS 6349	BS6349 Marine Structure Part 1.1 General - Code of Practice for Planning and Design of Operations (supersedes relevant parts of Part 1 (2000))
BS 6349	BS6349 Marine Structure Part 1.2 – General - Code of Practice for Assessment of Actions (refer BS6349 Part 1 (2000) above until part 1-2 is available)
BS 6349	BS6349 Marine Structure Part 1.3 General - Code of Practice for Geotechnical Designs (supersedes relevant parts of Part 1 (2000))
BS 6349	BS6349 Marine Structure Part 1.4 General - Code of Practice for Materials (supersedes relevant parts of Part 1 (2000))
BS 6349	Marine Structure Part 2 – 2010: Code of Practice for Design of Quay Walls, Jetties and Dolphins
BS 6349	Marine Structure Part 4 – 1994: Code of Practice for Design of Fendering and Mooring Systems
BS 6349	Marine Structure Part 5 – 1991: Code of Practice for Dredging and Land Reclamation
PIANC	Guidelines for the design of fender systems (2002)
PIANC	Harbour Approach Channels Design Guidelines (2014)
PIANC	Guidelines For Design of Armoured Slopes under Open Piled Quay Structures – Design Requirements
PIANC	Accelerated Low Water Corrosion
PIANC	Seismic Design Guidelines for Port Structures
Engineers Australia	Coastal Engineering Guidelines, May 2012
EPA Victoria	Guidelines for Dredging, Publication 691, Oct 2001
EAU	Recommendations of the Committee for Waterfront Structures
CIRIA	The Rock Manual (C683)
US Army Corps of Engineers	Coastal Engineering Manual
BCA	Building Code of Australia
HB 84-2006	Guide to Concrete Repair and Protection
WSA 03-2011-3.1	Water Supply Code of Australia Melbourne Retail Water Agencies (MRWA), Version 2
IALA	IALA Maritime Buoyage System
IALA	IALA Navguide: Aids to Navigation Manual
VicRoads and AustRoads Standards	Austroads Guide to Road design and supplementary Vic Roads design guidelines Parts 1 to 8. VicRoads Traffic Engineering Manual Volume 1 – Traffic Management. VicRoads Traffic Engineering Manual Volume 2 – Signs and Markings.
Interpave, 4th edition	The Structural Design of Heavy Duty Pavements for Ports and Other Industries.
Concrete Institute of Australia	Performance Criteria for Concrete in Marine Environments (2001) – recommended practice

4.1.2 Design Life

For structures where replacement, refurbishment or significant maintenance may interrupt commercial shipping, tug operations or terminal operations, the design life is 100 years. Where a design life is specified as less than 100 years, the specific elements must be designed for ease of replacement, refurbishment and significant maintenance at the end of the asset's service life.

Table 4-2 outlines the life for which the asset is intended to perform its specified design function without replacement, refurbishment or significant maintenance. Significant maintenance includes works that may interrupt commercial shipping, tug operations or terminal operations.

The specified design life is based on the premise that routine preventative and regular inspections and maintenance of the structures would be undertaken in accordance with standard practice for the specific structural elements. At the end of the design life the structure shall still be capable of carrying the design loads and perform its function as per the original design however further subsequent deterioration of the facility beyond its design life may limit the functionality and ongoing operations .

Table 4-2. Design Life Requirements

Asset	Design Life (Years)
Berth structures / access bridges	100
Road/Rail bridges	100
Reclamations and ground treatment	5 - 100[2]
Retaining walls that are part of the wharf	100
Other retaining walls	50
Sloping seawalls beneath quay structures	100
Other sloping seawalls	50
Other sloping seawalls and edge structures	100
Buildings	50
Drainage structures including culverts and pipes	50
Bollards	30
Cathodic protection and monitoring systems	30
Navigational Aids	30
Tug berth structures	50
Fenders	10
Terminal pavements – Concrete	40
Terminal pavements – Asphalt	25
Services	25
Access road pavements	20

[2] Decision is related to financial modelling outcomes / recommendations.

4.1.3 Stability Criteria

4.1.3.1 Slope Stability

The following minimum factors of safety (FOS) against potential deep slip failure modes are to be achieved for permanent dredged and reclamation slopes, temporary dredged slopes affecting new and existing structures, berth structures and edge structures using unfactored loads and material strengths:

Factor of safety against global instability (deep slip)

> 1.5 Normal loading

> 1.2 Extreme loading

> 1.1 Seismic loading

Ground water profiles and tidal lag effects used in the design shall be in accordance with AS4997.Consideration shall be given to the adverse effects of extreme sea levels in stability analysis.

For seismic loading consideration shall be given to dynamic loading and soil liquefaction.

Dredged slopes in navigation channels shall be targeted to be stable under the action of waves, currents or other hydrodynamic effects.

4.1.3.2 Retaining Structures

For marine structures, reference is made to the recommendations of AS4997. The following minimum factors of safety (FOS) against potential sliding, overturning and bearing capacity failure are to be achieved for permanent and temporary berth structures and edge structures using unfactored loads and material strengths:

Factor of safety against sliding

> 1.75 Normal loading

> 1.5 Extreme loading

> 1.1 Seismic loading

Factor of safety against overturning

> 2.0 Normal loading

> 1.5 Extreme loading

> 1.1 Seismic loading

For retaining walls on land, reference is made to the recommendations of AS4678.

For seismic loading consideration shall be given to dynamic loading and soil liquefaction.

Factor of safety against bearing failure

> 3.0 Normal loading

> 2.0 Extreme loading

> 1.5 Seismic loading

Conventional 2D equilibrium analysis is to be used in determining the factors of safety against potential failure modes.

Stability analyses shall take into consideration pore water pressures, imbalances in hydrostatic effects due to tidal lag and the effects of waves consistent with design event exposure, refer AS4997. Consideration shall be given to the relevant effects of global warming including adverse effects of extreme sea levels in stability analysis.

4.1.3.3 Settlement

Settlement shall be limited in keeping with the operational tolerances associated with the intended land-use. Tolerances for terminal operations will depend on the mode of operation and area and shall be confirmed

based on the terminal systems studies. Ground treatment including potentially surcharging and / or deep compaction within the terminal may be required to reduce residual settlements to acceptable limits over the operational design life.

Where necessary allowances should be made for structures and formation levels to be pre-set above targeted long term design finished levels to minimise the effects of residual settlement consistent with targeted tolerances outlined in Section 4.7.3.

4.1.3.4 Liquefaction

The potential for reclamation material to liquefy due to the design seismic events shall be considered and allowances made where appropriate to minimise the risks of liquefaction consistent with agreed risk levels.

4.2 Dredging

4.2.1 General

Dredged areas are to be designed to include allowance for maintenance dredging and where necessary provision is to be made for dredging extensions or deepening without destabilising adjacent slopes, scour protection or structures.

4.2.2 Criteria for Dredged Slopes

Permanent dredge slopes shall be designed with stability factors as specified in Section 4.1.3.

4.2.3 Tolerances and Limits

Specified dredging profiles shall be the minimum required for capital and maintenance dredging works. Dredging tolerances in the berth pocket alongside berths and in navigation channels shall reflect the likely dredging equipment to be used and material to be dredged. Until further assessments are undertaken the following allowances shall be used:

Note: - the quoted tolerances reflect maximum values for noted dredging plant.

- Vertical – 0.5m (1.0m in stiff to very stiff clays)
- Horizontal – 3.0m through the toelines where appropriate (5.0m in stiff to very stiff clays)

4.3 Reclamations and Edge Structures

4.3.1 Environmental Loads

Environmental loads considered in the design shall include coincident adverse effects from wind, waves, currents, hydrostatic loads as outlined in Section 2.4. Where possible the potential for wind shifts of up to 90 degrees shall be considered in limiting operational and storm events. Load combinations for maritime structures shall include separate normal operational and extreme event scenarios as specified in Section 4.6.1.7, taking into consideration the recommendations of AS4997, AS1170 Pt.4 and BS6349.

4.3.2 Live Loading

Live loading on finished level adjacent to seawalls other than berth structures shall be compatible with operational modes and no less than:

- Normal Operational Loading: 20 KPa;
- Extreme Environmental Loading (No operations): 10 KPa.

4.3.3 Seismic Design Criteria

Reclamations and edge structures shall be designed in accordance with AS 1170.4 Minimum design loads on structures – Part 4: Earthquake Loads.

The Importance levels relevant to this project are defined in Table 4-3 and listed for each structure type in Table 4-4.

Table 4-3 - Importance Level Definitions (AS1170 Part 0)

Importance Level	Category	Comment (AS 1170 Part 0)	Rationale
2	**Medium** consequence for loss of human life, or **considerable** economic, social or environmental consequences	Normal structures not falling into other levels	Normal structures
4	**High** consequence of loss of human life or **very great** economic, social or environmental consequences	Post-disaster structures (post-disaster functions or dangerous activities)	Very great economic consequences

Table 4-4 - Importance Level of Structures

Asset	Importance Level (AS1170 Part 0)
Berth structures / access bridges	2
Road/Rail bridges	2
Reclamations and ground treatment	4
Retaining walls	2
Sloping seawalls beneath quay	2
Other sloping seawalls and edge structures	2
Buildings	2
Other structures	2
Post disaster structures including associated retaining walls, sloping sea walls beneath structure	4

For an Importance Level 2 as per AS1170.0 Table F2 i.e. Normal structures and structures not falling into other levels, the design event in terms of annual probability of exceedance for earthquake loading for a 25, 50 and 100year design life is 1/250, 1/500 and 1/1000 respectively.

For an Importance Level 4 as per AS1170.0 Table F2 i.e. Structures with Post-disaster functions, the design event in terms of annual probability of exceedance for earthquake loading for a 25 and 50year design life is 1/1,000 and 1/2,500 respectively and for 100 year design life the return period is to be determined by risk assessment and is to be less than or equal to 1/2,500.

The earthquake hazard factor (Z) for the site (Port of Hastings) in accordance with Figure 3.2(a) of AS 1170.4 - 2007 Part 4: Earthquake Actions is Z = 0.10.

The sub-soil classification for the site is considered to correlate to Class De (Deep soil site) in accordance with AS 1170.4 - 2007 Part 4: Earthquake Actions.

The probability factor (Kp) shall be taken as detailed in AS1170.4 Table 3.1 based on the relevant annual probability of exceedance. For Importance Level 2 structures with a design life of 50 and 100 years, the annual probability of exceedance of the design event is 1/500 and 1/1,000 respectively and the probability factor Kp is equal to 1.0 and 1.3 respectively.

For structures with 50 year design life and Importance Level 2, Kp.Z = 1.0 x 0.10 = 0.10 and the Earthquake Design Category (EDC) in accordance with AS1170.4 Table 2.1 is:

- Category II - for structure height < 25m; and

- Category III - for a structure height $\geq$ 25m.

For structures with 100 year design life and Importance Level 2, Kp.Z = 1.3 x 0.10 = 0.13 and the Earthquake Design Category (EDC) in accordance with AS1170.4 Table 2.1 is as above ie:

- Category II - for structure height < 25m; and
- Category III - for a structure height $\geq$ 25m.

4.3.4 Stability Criteria

Edge structures such as structural or gravity retaining walls and sloping seawalls shall be designed to achieve minimum geotechnical stability factors specified in Section 4.1.3. Sloping revetments shall be protected against instability due to wave and hydraulic action and scour.

4.3.5 Revetments

4.3.5.1 Standards

Rock armour revetment shall comply with the requirements of the Rock Manual – The use of rock in hydraulic engineering (2nd edition) 2007 CIRIA/CUR.

4.3.5.2 Form and Functionality

Revetments shall not be steeper than 1:1.75. Formation slopes shall be consistent with the natural angle of repose of the material utilised at each stage of construction.

Seawall crest level and details shall consider sea level rise, potential wave overtopping and impact on landside operations as appropriate to the return period considered. Overtopping intensities shall not exceed the recommendations of *The Rock Manual – The use of rock in hydraulic engineering*.

4.3.5.3 Loads

Design events shall include wave effects associated with wind, surge levels and wave heights of H_{10} (representing the average of the highest 10% of waves in the wave spectrum) associated with the design storm event. H_{10} shall be taken to be equal to 1.27 x Hs, where Hs is the significant wave height based on Rayleigh theory, refer Section 2.4.5.

4.3.5.4 Stability

Geotechnical stability of seawalls shall include the local stability of revetment profiles. Rock armour sizing for revetment may utilise the Hudson Formula in line with the recommendations of BS6349. Revetment grading shall be graduated to retain finer materials against hydraulic wash out effects from currents and waves.

4.3.5.5 Armour

Rock and concrete armour for the revetment shall be designed based on the recommendations of BS 6349. Armour rock stability factors shall be in accordance with CIRIA/CUR (2007) and BS 6349 Part 1. Armour rock density factors shall take into account locally available rock resources. The density of saltwater shall be taken into account in armour stability assessments.

Alternative shore protection system using precast concrete units may be considered depending on cost and availability of rock armouring.

4.3.5.6 Acceptable Damage Levels

Damage level for design wave, and damage level for propeller wash from vessels and tugs shall take into account accessibility for maintenance and whole of life objectives.

Design of seawall revetments needs to allow for marine access for maintenance works. Permissible damage levels in the revetment design shall be consistent with use of the Hudson Formula for the design return period event and targeted time of first maintenance.

4.4 Dredge Spoil Disposal and Containment Structures

Stability criteria for dredged spoil and containment structures shall be as specified for dredged slopes in Section 4.1.3.

4.5 Onshore Earthworks

Stability criteria for onshore earthworks shall be as specified for slopes and retaining structures in Section 4.1.3.

4.6 Berth Structures

4.6.1 Loads

4.6.1.1 Environmental Loads

In addition to the requirements in Section 4.3.1 wave loads on berth structures are to be calculated using the average (most probable) maximum wave height in the design event equal to 1.9 times Hs, refer Figure 17 of BS6349 Part 1.

4.6.1.2 Berthing Loads

Berthing loads shall be determined in accordance with AS4997 and PIANC Guidelines for the Design of Fender Systems 2002.

The structure shall be checked for the following energy criteria to determine which is the most critical.

- Design Normal Energy – energy absorbed within normal recommended working stress limits specified by manufacturers;
- Abnormal Energy – energy absorbed without permanent damage to the structure. Abnormal berthing factors shall be applied to the normal berthing energy in accordance with PIANC 2002 guidelines. An abnormal energy factor of 1.75 shall be adopted for container vessel berthing and an abnormal energy factor of 2.0 shall be adopted for other vessels, refer PIANC Guidelines for the Design of Fender Systems 2002.

The berthing velocity is to be determined in accordance with AS 4997 - 2005, Figure B1 for good berthing in sheltered conditions and the following parameters are to be taken into account for the berthing loads on the basis that berthing will be tug assisted.

Table 4-5 – Berthing load parameters

Parameter	Container Vessel	RORO Vessel	Other Vessel
Berthing Point	Quarter	Quarter	Quarter
Maximum Approach Angle	10º	10º	10º

4.6.1.3 Mooring Loads

Mooring loads are to be determined in accordance with AS 4997 – 2005 for the full vessel spectrum.

The following serviceability loads are to be considered:

- 60 knots wind speed (30 second gust) from all directions;
- maximum current velocity concurrent with maximum wind/wave condition; and
- all states of tides with and without sea level rise allowance.
- vessel interaction effects combined with most adverse tidal current

4.6.1.4 Dead Loads

Dead loads to be assessed in accordance with AS 1170.1-2002

Material unit weights are to be in accordance with AS 1170.1-2002 or manufacturer's specifications where applicable.

Density of reinforced concrete = 25 kN/m3

Density of unreinforced concrete = 24 kN/m3

Density of steel = 78 kN/m3

4.6.1.5 Imposed Loads

The following loads shall be considered for international container wharves.

4.6.1.5.1 Uniformly Distributed Loads

The following global uniformly distributed loads are to be considered consistent with Table 5.1 of AS4997 for a primary port/international gateway container terminal:

- 10 kPa between the cope face and seaward container rail
- 50 kPa between the crane rails.
- 60kPa behind the rear crane rail.

4.6.1.5.2 Container Stacking Loads

Container stacking on the wharf is to be block stacking of containers, stacked up to 3 high and 1.5m from the front crane rail which complies with AS 4997 – 2005.Maximum 40ft container weight shall be 30.5 tonnes with allowance for reductions in weight for subsequent tiers.

Maximum contact point loads shall be taken from Table 4-8. This incorporates the recommendations from 'The Structural Design of Heavy Duty pavements for Ports and Other Industries (4^{th} Edition) pavement guidelines by Interpave that reflects alternative stacking arrangements.

4.6.1.5.3 Quay Cranes

The quay cranes shall be designed in accordance with operational requirements.

In addition to the dead and live quay crane loads, the following are to be considered:

- Worst combination of wheel load, wheel spacing and crane spacing considering both 8 wheel and 10 wheel bogie options for cranes;
- Number of adjacent cranes servicing a vessel as per Section 3.2.2.2
- Horizontal loads – to be no less than 15% of the vertical leg travel load being considered;
- Tie down loads – as specified by the manufacturer; need to state a minimum – manufacturer won't be known
- Storm pins loads – as specified by the manufacturer; need to state a minimum – manufacturer won't be known
- End buffers – no less than 1000 kN or as otherwise specified by the manufacturer.

4.6.1.5.4 Vehicles

The following vehicle loads shall be considered on the berth structure:

- 40 tonne lift capacity forklift (laden and unladen) in accordance with AS 4997 – 2005.
- 40 tonne lift capacity reach-stackers (laden and unladen) in accordance with AS 4997 – 2005.
- 40 tonne lift capacity straddle carriers in in accordance with AS 4997 – 2005.
- 70 tonne lift capacity AGV
- Vehicle Load – SM1600 in accordance with AS 5100.2 (bridge code).

- Loads arising from typical maintenance crane access and operations.

4.6.1.5.5 Hatch Covers

Hatch cover loads for the design vessels shall be considered up to 3 high on the wharf or in the back reach area extending 25m behind the landside crane rail.

4.6.1.5.6 Heavy Load Areas

Heavy load areas shall be designed for the delivery of quay cranes and other heavy equipment that is still to be defined.

4.6.1.6 Load Factors

Load factors to be used in the evaluation of ultimate limit state design are shown in Table 4-6, refer AS1170 Part 0 Section 4, AS4997 Section 5.12 and BS6349 Part 2 Annex A.

Table 4-6 Load Factors

Load Type – Primary Load Cases	Load Factor (Ultimate Limit State - ULS)
LC1 - Dead Load	1.2
LC2 - Deck UDL	1.5
LC3 - Container Crane	1.5
LC4 - Container Crane Storm Tie Down	1.0
LC5 - Mobile Harbour Crane (MHC)	1.5
LC6 - Forklift	1.5
LC7 - Mooring Loads (Crane Operating/Not Operating)	1.5
LC8 - Mooring Loads (Extreme Mooring Conditions)	1.1
LC9 - Berthing Loads (Abnormal/Normal)	1.5
LC10 – Wave Loads	1.5
LC11 – Geotechnical Loads	1.5

4.6.1.7 Load Combinations

Load combinations shall be as specified in this document which has been based on recommendations of AS 1170.1-2002, AS 4997-2005 and BS 6349 and are shown in Table 4-7.

Table 4-7. Load Combinations

Combined Load Cases		Description
Ultimate Limit State		
LC21	1.2LC1 + 1.5LC2	Dead + Live UDL
LC22	1.2LC1 + 1.0LC2 + 1.5LC3	Dead + Live UDL + Container Crane
LC23	1.2LC1 + 1.5LC6	Dead + Forklift
LC24	1.2LC1 + 1.5LC3	Dead + Container Crane
LC25	1.2LC1 + 1.0LC2 + 1.5LC3 + 1.5LC7	Dead + Live UDL + Container Crane + Mooring(Operating)
LC26	1.2LC1 + 1.5LC2 + 1.0LC9	Dead + Live UDL + Mooring (Extreme Mooring Limits)
LC27	1.2LC1 + 1.5LC2 + 1.2LC3 + 0.5LC9	Dead + Live UDL + Container Crane + Berthing

Combined Load Cases		Description
LC28	1.2LC1 + 1.5LC2 + 1.0LC9	Dead + Live UDL + Berthing
LC29	1.2LC1 + 1.0LC2 +1.5LC9	Dead + Live UDL + Berthing
LC30	(1.2 or 0.85)LC1 + LC4	Dead + Crane Storm Tie Down
LC31	(1.2 or 0.85)LC1 + 1.5LC9	Dead + Berthing
LC32	(1.2 or 0.85)LC1 + 1.5LC7	Dead + Mooring (Operating)
LC33	(1.2 or 0.85)LC1 + 1.0LC8	Dead + Mooring (Ultimate Mooring Limits)
Serviceability Limit State		
LC34	1.0LC1 + 1.0LC2	Dead + Live UDL
LC35	1.0LC1 + 1.0LC2 +1.0LC3	Dead + Live UDL + Container Crane
LC36	1.0LC1 + 1.0LC6	Dead + Forklift
LC37	1.0LC1 + 1.0LC2 + 1.0LC3 + 1.0LC7	Dead + Live UDL+ Container Crane + Mooring (Operating)
LC38	1.0LC1 + 1.0LC2 + 1.0LC3 + 1.0LC9	Dead + Live UDL + Container Crane + Berthing
LC34	1.0LC1 + 1.0LC2	Dead + Live UDL

Seismic design shall consider a 70% reduction in live load associated with the combined probability of coincidence of live load with a seismic event, refer AS1170 Section 6.2.2.

4.6.1.8 Seismic Design Criteria

Berth structures must be designed for seismic load effects in accordance with AS 1170.4 Minimum design loads on structures – Part 4: Earthquake Loads. Lateral deflections shall not exceed 1.5% of the height of the structure for the relevant design event as specified in Section 4.3.3.

4.6.2 Serviceability Criteria

Serviceability design criteria for marine structures including quays and access bridges shall include limitations on overall structural lateral deflections and limitations on working load reinforcement stresses and/or crack widths in reinforced concrete, refer Section 6.3.7.2 of AS4997.

4.6.3 Deck Level

The top of the cope level is to be designed to take into account the requirements for access and maintenance of the wharf structure together with the combined effects of extreme water levels, waves including standing waves and future sea level rise. An open piled shall structure shall not be at risk of uplift.

4.6.4 Earth Retaining Structures

.Earth retaining structures adjacent to roadways are to be designed for the effects of vehicle surcharge loads in accordance with AS 5100.2 in addition to other loads.

4.6.5 Scour Protection

The structures are to be designed to consider scour potential around the structures from vessel propellers and thrusters, wave and current action. The design will either incorporate scour protection measures to prevent its occurrence over the design life of the structure, or allow for potential scour in the design. The design of scour protection measures is to consider future stages of the port development including deepening.

4.6.6 Stability Criteria

The hydraulic stability of any seawall revetment underlying quay structures or adjacent to berths shall be designed to cater for vessel manoeuvring alongside including operation of bow thrusters and the effects of main propellers and tugs.

4.6.7 Fenders

The fenders are to be designed in accordance with PIANC Guidelines for the Design of Fender Systems and are to consider the following:

- Losses due to manufacturer's tolerances, temperature effects and berthing angle;
- Minimum shear loads equal to 20% of the maximum rated reaction;
- The maximum allowable hull pressure for the full spectrum of vessels which shall not exceed 20t/m2, refer PIANC Guidelines for the Design of Fender Systems 2002;
- Suitable for the full spectrum of vessels for the full tidal range including sea level rise;
- Direct impact on one fender or between fenders whilst maintaining a clearance of at least 500mm between hull and cope line / quay crane.
- Fender spacing to suit the full range of container and non-container vessels

4.7 Terminal Pavements and Foundations

4.7.1 Standards

Terminal pavements are to be designed in accordance with the recommendations of the Interpave publication, Structural Design of Heavy Duty Pavements for Ports and other Industries, 4th edition and cross-checked for compliance with Austroads and Vic Roads standards.

4.7.2 Loads

4.7.2.1 Containers

The design of container yard pavements should take into account the fact that not all containers are fully loaded. The maximum contact loads and distribution of container loads on pavements will be taken in line with the Structural Design of Heavy Duty Pavements for Ports and other Industries publication, and the container corner casting loads as shown in Table 4-8 shall be considered.

Table 4-8 Container corner casting loads by container stacking arrangement

Stack Height	Reduction in Gross Weight	Contact Stress (N/mm2)	Load on Pavement (kN) for each stacking arrangement		
			Single	Row	Block
1	0	2.59	76	152	305
2	10%	4.67	137	274	549
3	20%	6.23	183	366	732
4	40%	7.27	213	427	853
5	40%	7.78	229	457	914

4.7.2.2 Equipment

Equipment load information shall be adopted from that presented in Section 4.6.1.5.4.

4.7.3 Grading and Settlement

The limitations on surface grade for alternative terminal equipment shall be adopted as per Table 4-9.

Table 4-9. Preliminary Grading Limitations

Area	Maximum Slopes
Straddles	

Area	Maximum Slopes
• Transverse • Longitudinal	2% 2%
RTGC • Transverse • Longitudinal	 1% 1%
ASCs/RMGC • Transverse • Longitudinal	 1% 1%
Truck Access Roads • Max road crossfall • Longitudinal grade • Crossfall rollovers	 4% 0.3 - 4% 0.1% in 5m

4.7.4 Pavement Subgrade Conditions

The design pavement subgrade conditions will be based on the available geotechnical site conditions information and proposed earthworks/reclamation. Capping layers will be provided depending on the assumed subgrade strength in accordance with the Structural Design of Heavy Duty Pavements for Ports and other Industries publication.

4.7.5 Pavement Types

Pavement types will be selected based on performance requirements and taking into account the accepted maintenance strategy. Rigid and flexible pavements will be considered.

4.7.6 Differential Settlement Criteria

Differential settlement criteria for pavements will be specified to suit the operational equipment requirements and/or the adopted maintenance strategy, as appropriate.

4.8 Terminal Structures and Buildings (if required)

Building requirements will be confirmed and quantified based on a floor areas following terminal and operations design.

4.9 Terminal Utility Services

4.9.1 Stormwater

All stormwater drainage shall be designed in accordance with AS/NZS 3500:3 and relevant statutory best practice guidelines for treatment of sediments and nutrient, and containment of pollutants such as the CSIRO 1999 Urban Stormwater Best Practice Environmental Management Guidelines.

The stormwater drainage design shall meet the following design parameters Table 4-10

Table 4-10. Stormwater Drainage Design Parameters

Parameter	Value
Primary drainage network	20 year ARI
Overland flow	100 year ARI

Parameter	Value
Time of concentration	5 minutes
Flow path depths	Road – 10mm Terminal – To be defined

Drainage design shall take into account the coincident effects of relevant storm surges and adverse potential effects of differential settlement. Provisions for self-cleansing of drainage systems shall be in accordance with relevant guidelines.

Stormwater interception and retention facilities shall be incorporated in the drainage network where required.

4.9.2 Potable Water

The design of new water mains is to be undertaken in accordance with Water Supply Code of Australia WSA 03-2002-2.3 (Melbourne Retail Water Agencies Edition – Version 1).

4.9.3 Sewerage

The design of new sewage infrastructure is to be undertaken in accordance with the Water Services Association of Australia (WSAA) publication 'WSA 02 Gravity Sewerage Code of Australia Version 3.1 (1 July 2014)' and any relevant supplementary publications from South East Water.

Unit rates for sewage demand shall be in accordance with the Sewerage Code of Australia, Melbourne Retail Water Agencies Edition, Version 1.0 (WSA 02-2011) to reflect commercial / industrial classes of use.

4.9.4 Electrical

The design of new power infrastructure is to be undertaken in accordance with the relevant Ausgrid Network Standards, AS 3000 and any relevant supplementary publications from United Energy or AusNet.

Unit rates for power demand shall be in accordance with those presented in Table 4-11, unless specified otherwise.

Table 4-11. Unit power demand estimates for equipment and usage type

Equipment / Usage type	Unit consumption	Source
Ship to shore gantry crane	140 kWh / hr	None specified – based on previous project experience
Rail mounted yard gantry crane	110 kWh / hr	
Refrigerated containers	2.5 kWh / hr	
Lighting	3.5 kWh / m2 / year	
Offices and workshops (Terminal)	0.1 kWh / m2 / hr	
Power supply to ships (cold ironing)	2000 kWh / ship / hr	
Offices and workshops (General)	100 VA/m2	Table C3 AS/NSZ 3000:2007
Retail (light, power and air conditioning)	100 VA/m2	Table C3 AS/NSZ 3000:2007
Warehousing & bonded warehousing (light, power and ventilation)	15 VA/m2	Table C3 AS/NSZ 3000:2007
Light Industrial (light, power, air-conditioning and equipment)	80 VA/m2	Table C3 AS/NSZ 3000:2007
Manufacturing	80 VA/m2	Table C3 AS/NSZ 3000:2007

Accommodation	80 VA/m2	Table C3 AS/NSZ 3000:2007
Carparks	5 VA/m2	Table C3 AS/NSZ 3000:2007
Road Lighting	2 VA/m2	Vic Roads guidelines

4.9.5 Lighting

Lighting lux level performance requirements in various operational areas are outlined in Table 4-12.

Lighting shall be designed to prevent light spill in accordance with AS 4282.

Table 4-12. Lux Level Requirements

Area	Lighting Requirements
Terminal	
Terminal operational areas	Average 50 lux (min 20 lux)
Access routes for mobile equipment	Average 20 lux, (min 10 lux)
General operational areas	Average 20 lux, (min 10 lux)
Perimeter areas	Average 15 lux +/- 30%
Gates and entrances	Average 40 lux +/- 30%;
Berths	Average 15 lux +/- 30%
Pedestrian areas	AS1158.3.1
Road	As per Vicroads standards
Rail	Average 50 lux (min 20 lux)

4.9.6 Communications and Security

A CCTV surveillance system is to be suitable for the requirements of the operators and the Authority in meeting the requirements of the Maritime Transport Security Act 2003. The CCTV surveillance system will utilise the conduit corridors and towers for the lighting system in the terminal and be capable of 24 hours per day operation in all weather conditions, without interference in operation by passing vessels or vehicles and capable of recognition of the registration number on vehicles and human sized objects within and around the terminal.

4.9.7 Fire Fighting Systems

The fire water system shall be designed in accordance with BCA 2012 and AS 2419.1-2005.

Fire hydrants shall be positioned at regular intervals around the terminal such that firefighting extends to all parts of the terminal footprint based on a 20m appliance hose plus 60m fire hose plus 10m throw.

4.9.8 Bunker Facility (if required)

Bunkering facilities may include low sulphur fuel, LPG, water etc to be incorporated at the berth depending on perceived demand

4.10 Port Services Infrastructure

The requirements for Port Services infrastructure are included in Section 3.5.

4.11 Security

The requirements for security are to be defined following liaison with regulatory authorities.

4.12 Navigation Aids

Navigation aids are to be designed in accordance with relevant IALA Recommendations and Guidelines. A combination of buoys and beacons shall be considered.

Navigation beacon structures shall include a support base pile, top structure adapter, platform with handrail, day marker, navigation light stand, navigation light, navigation aid back-up power supply, access ladder to platform, hardwood fender and sacrificial anode(s) on pile.

Allowances for fatigue loading effects are to be taken into account for monopile beacons in accordance with AS4100, in particular Section 11 of AS 4100. Water based navigational structures are to be designed for safe access for servicing and maintenance vessels and crew. Additionally loads imposed by maintenance vessels are to be considered. The potential for fatigue effects due to vortex shedding in areas of strong current shall be considered in the design.

4.13 Terminal Access Roads and Bridges

4.13.1 Outside the SUZ 1

Road design outside the SUZ1 area is covered by Vic Roads, and is not covered by this document.

4.13.2 Geometric Road Design Criteria in the SUZ1

Access roads to the terminal within the SUZ1 area will comply with the following criteria in Table 4-13, unless otherwise specified.

Table 4-13. Access Road Geometric Design Criteria

Item	Design Criteria
Design Speed (Horizontal and Vertical Alignment)	80 km/h
Posted Speed Limit	60 km/h
Sight Distance	• The minimum sight distance is the stopping sight distance • The stopping sight distance must comply with the design speeds
Horizontal Alignment	Minimum curves at intersections – 20m
Vertical Alignment	Maximum grades at intersection – 3% Maximum allowable grade elsewhere – 5%
Design Vehicle	Super B-double

Terminal internal roads will comply with the following criteria in Table 4-14.

Table 4-14. Terminal Internal Road Geometric Design Criteria

Item	Design Criteria
Design Speed (Horizontal and Vertical Alignment)	40 km/h
Posted Speed Limit	20 km/h
Sight Distance	• The minimum sight distance is the stopping sight

Item	Design Criteria
	distance • The stopping sight distance must comply with the design speeds
Horizontal Alignment	Minimum curves at intersections – 20m
Vertical Alignment	Maximum grades at intersection – 3% Maximum allowable grade elsewhere – 5%
Design Vehicle	Super B-double

4.13.3 Pavements

4.13.3.1 Design Criteria

Traffic load distribution must be determined in accordance with AUSTROADS Pavement Design Guide.

The pavement is to be designed for the expected annual average daily traffic volumes determined by the transport modelling studies..

4.13.3.2 Performance Criteria

Performance Criteria for pavements will be developed based on the proposed pavement types and maintenance strategy taking into account whole of life costing considerations.

4.13.4 SubSurface Drainage

Allowance shall be made for sub-surface drainage to be made in areas of potential water ingress such as from groundwater beneath the pavements or at pavement joint locations.

4.14 Terminal Rail Access and Sidings

4.14.1 Geometric Design Criteria

The following principal design standards are to be as the basis for the preliminary rail alignment design:

- Victorian Rail Infrastructure and Operator Group Standards (VRIOGS) 001 Structural Gauge Envelopes
- Victorian Rail Infrastructure and Operator Group Standards (VRIOGS) 004.1 Heavy Rail Track Design Manual
- V/Line Track Design Manual NIST-2618

Rail Infrastructure within the SUZ1 area will comply with the following criteria in Table 4-15, unless otherwise specified.

Table 4-15. Rail Geometric Design Criteria

Item	Design Criteria
Track Gauge – AARL Passenger - Broad Gauge Track Gauge – Standard Gauge	1.60m 1.435m
Track Centres	4.50m
Line Speed	80km/hr (min)

Item	Design Criteria
Track Grades	1:50 (2%) maximum 1:150 (0.67%) absolute maximum
Structural Clearance	Horizontal 4.00m desirable minimum – fence/retaining wall 1.55m – platform edge Vertical 5.75m - passenger services 7.10m – Freight services (Double Stacked Containers where applicable)
Horizontal Geometry	250m minimum radius 450m optimum radius 25m minimum length of straight between horizontal curves Cant Applied Cant = 80mm maximum Cant Deficiency = 85mm maximum
Vertical Geometry	6700m minimum Sag radius 3350m minimum Summit radius 25m minimum length between vertical curves
Turnouts BG (1:15 tangential)	1:15 crossing angle, 800m radius, 65km/hr diverge speed 60kg/m rail on full depth concrete bearers
Track Formation and Ballast	60kg/m rail on full depth concrete sleepers 300mm minimum ballast depth below sleeper 400mm minimum ballast shoulder widths with a minimum 1m clearance to edge of capping and 1:1.5 shoulder slope

4.15 Port Precinct Infrastructure

Design criteria for port precinct infrastructure shall be in accordance with regulatory Authority requirements and relevant Australian Standards.

4.16 Port Environs Infrastructure

Design criteria for port environs infrastructure shall be in accordance with regulatory Authority requirements and relevant Australian Standards.

Appendix A Glossary

The acronyms and terminology used in this document are outlined in the following table.

Table A-1. Glossary of Terms

Acronym / Term	Definition
Abutment	Structure at Landward termination of jetty.
ACRMG	Automated Cantilevered Rail Mounted Gantry Crane
AGV	Automated Guided Vehicle
Aids to Navigation	Markers with known charted positions located and designed to enable mariners to avoid dangers and/or fix their positions.
Anchorage	Area designated by the Authority for anchorage of vessels waiting for a berth or distressed or impaired vessels.
Approach Channel	Any stretch of waterway linking the berths of a port and the open sea
ARTG	Automated Rubber Tyred Gantry
ASC	Automated Stacking Crane
AShC	Automated Shuttle Carrier
AutoStrad	Automated Straddle Carrier
Berth	Location(s) alongside of the Wharf where vessels berth and moor for loading, including berthing and mooring dolphins.
Berth Pocket	Dredged area along each side of the Wharf, with depth sufficient to accommodate fully laden vessels at Lowest Astronomical Tide
Berthing	The action of coming alongside and mooring the vessel to the wharf. Berthing Dolphin Supports fender and mooring line hooks.
Cardinal Marker	Marker that indicates the direction of the safest water. They indicate the safe side to pass a danger or a feature, such as a bend in channel or end of a shoal.
CEPEX	Capital Expenditure
Channel Marker	Marker used to show well established channels, indicating the port (left) and starboard (right) hand side of channels in accordance with IALA Maritime Buoyage System Region A (red to port), where the (fairway) direction of travel for reference is the one leading from the sea.
Container Exchange Rate	The average number of TEU movements onto and off a vessel as a ratio to the vessel's capacity in TEU.
Container Ratio	The number of TEU per container, reflective of the mix of twenty-foot and forty-foot containers. The Container Ratio is always a number between 1 and 2; 1 being a container mixture of solely twenty-foot units, and 2 being a container mixture of solely forty-foot units.
Crane Intensity	The total number of cranes applied to a particular vessel, divided by the vessel length. For example a 275m vessel being worked by 3 cranes has a crane intensity of 92m
CRMG	Cantilevered Rail Mounted Gantry
D%TAB	Delays as a percentage of time at berth
Delay as a % of Time at Berth (D%TAB)	The Waiting Time at anchorage for inbound vessels as a percentage of total Time at Berth
Delays	Waiting time for both inbound and outbound vessels due to channels, swing basins or berths being occupied. Typically vessels delayed by more than 4 hours will move to anchorage, however smaller delays can be handled through slow steaming.
DES	Discrete Event Simulation
Distribution Centre (DC)	A freight facility used for destuffing containers into smaller consignments for distribution into retail facilities or manufacturing centres
Ebb Tide	TBC

Acronym / Term	Definition
FCL	Full Container Load
Fleet Spectrum	The total number of recorded or projected vessels calling at a port each year, broken down into discrete vessel classes based on capacity.
Flood Tide	TBC
Forecast Throughput	The projected volumes of any trade type expected to be transported through the various ports in a particular year.
GCR	Gross Crane Rate
GMBL	Guaranteed minimum breaking load of a mooring line.
GMPH	Gross container moves per hour
Gross Crane Rate (GCR)	The average number of cranes' moves per hour for a crane over a year taking into account downtime for maintenance.
Gross Tonnage (GT)	Formerly known as Gross Registered Tonnage (GRT)
HTE	Horizontal Transfer Equipment
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities.
ISA	Intermediate Stacking Area
LCL	Less than full Container Load
LPG	Liquified Petroleum Gas
LOA	Length Over All
Lo-Lo	Lift On / Lift Off
Marker Buoy	A yellow marker with a cross used to indicate a special area.
Maximum Design Draught	The maximum draught at which the vessel can safely sail with respect to classification rules and load line regulations and the draught is measured vertically from the lowest point on the hull to the water level when at the maximum permissible summer load line. This is sometimes referred to the scantling draught
Mooring Dolphin	Supports mooring link hooks, no fender.
Navigation Leads	A pair of navigation marks used to indicate a safe passage for vessels entering a shallow or dangerous channel. Leads are separated in distance and elevation, so that when lined up vertically with one behind the other, they provide bearing.
Net Crane Rate (NCR)	The average number of container lifts per hour for a crane whilst it is working.
Non-working Time at Berth	The time when a vessel is at berth but no containers are being exchanged i.e. cranes are not working the vessel. This time includes time for fixing and releasing lines, lashing and unlashing containers, opening hatches and any other delays due to stevedore working practices such as changing crew work shifts. Unless specified otherwise, the value used in this report is the average for all vessels throughout each year.
OD	Origin / Destination
OPEX	Operational and maintenance costs
Passing Separation	Distance between two passing vessels. Measured as side to side, not centreline to centreline.
Pbm	Per berth metre
Peaking factor	The ratio of the maximum monthly throughput for the port to the 12-monthly average throughput for the relevant year
PICI	Port Interface Cost Index
Port Marker	A red square marker indicating the port (left) hand side of the channel. When travelling upstream (or entering a harbour), leave port hand marks on the port side. When travelling downstream (or when leaving harbour), leave port hand marks on the starboard side.
Port planning factor	A reduction factor applied to the Theoretical Capacity to provide a capacity buffer which facilitates a competitive environment between the stevedores
QC	Quay Crane
Quad-lift	A quayside crane capable of lifting four TEUs (four twenty-foot or two forty-foot

Acronym / Term	Definition
	containers) simultaneously.
Quay Occupancy	The ratio of the average cumulative length of vessels alongside at any one time to the total quay length.
RMG	Rail Mounted Gantry Crane
Ro-Ro	Roll On /Roll Off
RTG	Rubber Tyred Gantry Crane
Sailing Draught	The draught of the vessel at arrival or departure from a port when it is at rest. Typically this is measured at the bow, amidships and stern prior to departure to confirm that it can leave the port and enter the next port safely. This is sometimes referred to as the running draught
SC	Straddle Carrier
Sector Light	An aid to navigation that indicates safe channel through shallow or dangerous waters. There are usually three lights of different colours identifying a sector of an arc. The white centre sector indicates the safe water, and the red and green sectors either side indicate areas to avoid.
Ship Access Gangway	Gangway for personnel access to the moored vessel.
Starboard Marker	A green triangle marker indicating the starboard (right) hand side of the channel. When travelling upstream (or entering a harbour), leave starboard hand marks on the starboard side. When travelling downstream (or when leaving harbour), leave starboard hand marks on the port side.
Swing basin	Designated area for turning vessels prior to berthing or following unberthing
TEU	Twenty-Foot Equivalent Unit
Theoretical Capacity	The maximum throughput (in TEU) that can be handled by the facility before the key performance benchmark(s) is breached
Throughput	The number of containers (in TEU) passing through the terminal in a particular year
Tide	TBC
Time at Berth (TAB)	The total time between first lines on and last lines off for each vessel. Time at berth generally includes time for fixing mooring lines, transferring cargo, opening and closing hatches and administrative tasks.
TOS	Terminal Operating System
Transhipment	The use of a central aggregation/disaggregation point for the shipment of containers within a broader region.
TTT	Truck turnaround time
Twin-lift	A quayside crane capable of lifting two twenty-foot containers simultaneously
ULP	Unleaded Petrol
Unberthing	The action of removing the vessel from the wharf in preparation to depart.
Unitized Cellular Container ship (UCC)	A type of specialised container ship
VBS	Vehicle Booking System used to schedule trucks at a container terminal). Similar to the TAS system which is used by Hutchison Ports Australia
Vessel Class	A grouping of vessels based on their TEU capacity.
Vessel Working Time	The time taken per vessel to unload and load all of the containers to be exchanged, i.e. the time when cranes are actively working the vessel.
Waiting Time (at anchorage)	The time elapsed whilst vessels are held at anchorage due to insufficient berth length being available to enable them to dock, or channel unavailability.
WCCUs	Wheeled Cargo Carrying Units
WT/ST	Waiting Time to Service Time ratio
WTST%	Wait Time to Service Time Percentage

Appendix B References

The following table outlines the reports referenced in this document and their revision at the date of issue of each revision of this document.

Table B-1. References

No.	Title	Date	Company / Workstream	Document No.	Status
1	Port of Hastings 2013 Description Report – Hydrodynamics Report	March 2013	Cardno	NA49913530	Version 0.1
2	Multi Criteria Assessment Report	October 2013	GHD/AECOM	-	-
3	Port of Hastings 2013 Descriptive Report	17 December 2013	GHD/AECOM	-	Rev E - Final Draft
4	Port Options Summary Report	May 2014	GHD/AECOM	-	-
5	Topographic and Feature Survey Report	3 July 2014	Watsons Pty Ltd	36585	Version 1
6	Referral Concept Report	9 July 2014	Design & Engineering - AECOM + GHD Joint Venture	AGH-CEP0-DE-REP-0002	Rev B - Draft
7	Sustainability and Durability Principles Summary Report	21 July 2014	Design & Engineering - AECOM + GHD Joint Venture	AGH-CEP0-DE-REP-0004	Rev 2
8	Geotechnical Interpretative Report	5 Nov 2014	Design & Engineering - AECOM + GHD Joint Venture	AGH-CEP0-DE-REP-0009	Rev A
9	Throughput Forecast and Shipping Study	7 October 2014	Commercial and Economic - GHD	N/A	-
10	Preliminary Information for Basis of Design - Hydrodynamic, Water Quality and Meteorological Data	15 May 2014	Hydrodynamic - Haskoning	HAS-CEP0-HY-REP-0001	Rev A
11	Victorian Coastal Strategy	July 2014	Victorian Coastal Council		
12	Maximum Ship Size Particulars for Referral Design	15 May 2014	Commercial and Economic - GHD	N/A	-
13	Sailing Draughts in the Port of Melbourne	Not Yet Issued	Commercial and Economic - GHD	TBC	-
14	Services & Utilities Assessment report	March 2015	D&E – GHD/AECOM JV	AGH-CEP0-DE-REP-0017	Rev B