EASTLAND PORT LTD

Capital and Maintenance Dredging and Disposal

Port Navigation Channel, Vessel Turning Basin and Wharves 6-8

Coastal Permit Applications

Engineering Report

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07 March 2022

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PROJECT 301015-04045 - Capital and Maintenance Dredging and Disposal - Port Navigation Channel, Vessel Turning Basin and Wharves 6-8

Coastal Permit Applications

Engineering Report

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev B	Re-issued for Review	C. Adamantidis	C. Thomas/ D. Aubourg	D. Aubourg	07 December 2020		
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1. Introduction

Eastland Port Ltd (EPL) has a requirement to obtain resource consent for capital and future maintenance dredging and dredge spoil disposal operations at the port of Gisborne. This report has been prepared to provide engineering information regarding the existing maintenance dredging, proposed capital dredging and future maintenance dredging aspect of these consent applications. Reports have been prepared by others regarding the disposal aspects. Further details on the full application and associated reports can be found in the Assessment of Effects on the Environment prepared for this application (4Sight Consulting, 2018) (AEE). As noted in the AEE (4Sight Consulting, 2018), there is presently a consent application lodged with the Gisborne District Council for maintenance dredging of the port (4Sight Consulting, 2020). Capital dredging of some locations covered by this application will now be required, so that 200 m and 185 m ships can be accommodated at Wharf 7 and 8. Given the expected long-term duration that consent is being applied for (> 20 years), the capital and future maintenance dredge design levels, volumes and areas have been determined to provide sufficient depth to accommodate deeper draught vessels in the future. The locations for which capital dredging consent is being sought are shown in Figure 3-4:

- Port Navigation Channel
- Low Speed Ship Manoeuvring Area adjacent to Wharves 7 and 8
- Berth pockets for Wharves 7 and 8
- Vessel Turning Basin.

Capital dredging of the Wharf 6, Wharf 5 and Wharf 4 locations is not being applied for.

For consistency of maintenance dredging consent conditions, future ongoing maintenance dredging of the following locations is being sought as part of this application:

- Port Navigation Channel
- Low Speed Ship Manoeuvring Area adjacent to Wharves 7 and 8
- Vessel Turning Basin
- Wharf 7 and 8 Berth Pockets
- A section of the Wharf 6 Berth Pocket.

This report covers the following items:

- Section 2 details the existing maintenance dredge levels discussed in the previous consent application engineering report issued in early 2020 (Worley, 2020)
- Section 3 details the proposed capital dredge design levels, volumes and areas
- Section 4 details the final maintenance dredge design levels, volumes and areas
- Section 5 discusses the dredge material for both capital and maintenance dredging
- Section 6 documents the proposed method of dredging and disposal.

1.1 Declared Level and Design Dredge Level

In relation to this report, when designing structures and undertaking dredging two levels are considered. These are:

- Declared dredge level – this is the minimum level the dredge must achieve during a dredging campaign and is subsequently used by the port to determine the maximum draught of vessels using a particular location.
- Design dredge level. Due to construction tolerances associated with dredging and hydrographic surveying, it is not possible to dredge to the exact declared dredge level. An allowance for these tolerances is added to the declared dredge level to determine the maximum level which may actually be dredged in a location. Within Eastland Port this level cannot be exceeded due to undermining of adjacent structures. For Eastland Port these tolerances have been set at:
  - Dredge Tolerance +0.5 m (i.e. deeper)
  - Survey Tolerance +/- 0.1 m
  - Total Maximum Tolerance +0.6 m (i.e. deeper).

The actual level at any given location, after dredging, will be a value somewhere between the Declared and Design dredge level.

Previous consents applied for by EPL have included either the Declared or Design dredge level. For this consent, all levels have been provided as the Design dredge level.

1.2 Acronym and Glossary List

Acronym and Glossary List Table

A	**A**
AEE	Assessment of Effects on the Environment
B	**B**
BHD	Backhoe Dredge
C	**c**
CSD	Cutter Suction Dredge
E	**e**
EPL	Eastland Port Ltd
I	**i**
IH	Inner Harbour
M	**m**
mCD	Metres Chart Datum (1.056 m below MSL (1926))
MDLGAR 2019	Maintenance Dredging Liaison Group Annual Report 2019
MSL	Mean Sea Level
N	**n**
NZ	New Zealand

O	**o**
OSDG	Offshore Spoil Disposal Ground
P	**p**
PNC	Port Navigation Channel
S	**s**
SOP	Standard Operating Procedure
SUKC	Static Under Keel Clearance
SWMS	Safe Work Method Statement
T	**t**
TSHD	Trailing Suction Hopper Dredge
U	**U**
UKC	Under Keel Clearance
V	**v**
VTB	Vessel Turning Basin

2. Existing Maintenance Dredging Layout

Capital and maintenance dredging activities have been undertaken at the port since the 1880's (4Sight Consulting, 2020). While levels within most of the port have been maintained at their capital dredge levels, as vessel requirements change some locations have been maintained at shallower levels as vessels did not require the original capital dredge level. EPL submitted an application in early 2020 to include all the locations with previously approved maintenance dredging coastal permits (4Sight Consulting, 2020). These dredge levels are discussed in Sections 2.1.1 to 2.1.5, which in all cases included consideration of the impact of dredging on the stability of existing structures.

Figure 2-1 to Figure 2-3 show the locations and existing maintenance dredge level for the existing maintenance dredging application.

2.1 Dredge Levels and Locations

2.1.1 Port Navigation Channel

WorleyParsons undertook a study to determine the required Design Dredge Level for the Inner Port Navigation Channel (from the outer end of the breakwater to the Low Speed Ship Manoeuvring Area) and found this to be -11.0 mCD (WorleyParsons, 2018).

2.1.2 Vessel Turning Basin and Low Speed Ship Manoeuvring Area

As noted in the recent maintenance dredge application (4Sight Consulting, 2020), the original capital dredge level for the VTB allowed loaded ships to turn within the port, however within recent years it has only been maintained to a level allowing the turning of ballasted (unloaded) ships. This reduced dredge level restricts some vessels from using the port, such as

- Part loaded log vessels, which visit many other NZ ports
- Cruise ships, which need to lighter people ashore. This means that in bad weather these vessels cancel their Gisborne stop as they cannot safely transfer people into the lighters.

EPL is also considering the opportunity for container ships, such as Pacifica's "Moana Chief", to visit the port, however this may not be possible due to the shallow level of the VTB.

Due to these reasons, as part of the recent maintenance dredge application EPL have applied to maintain the VTB at its historical capital Design Dredge Level of -10.5 mCD, with a refinement of part of the VTB to be dredged to -7.5 m to allow for manoeuvring of tugs and other shallow draught vessels while ships are turning.

Consent is being sought for capital dredging to lower the Design Dredge Level for the Low Speed Ship Manoeuvring Area as discussed in Section 3.

2.1.3 Wharf 8 Berth Pocket

Based on investigations by Worley (WorleyParsons, 2017) it was determined for the existing maintenance dredging application that the Design Dredge Level would be -10.9 mCD. Consent is being sought for capital dredging associated with an extension of Wharf 8 as discussed in Section 3.

2.1.4 Wharf 7 Berth Pocket

Based on design drawings (John Booth, Sweetman and Wolfe, Nov 1964) it was determined that the Design Dredge Level for the Wharf 7 Berth Pocket is -9.7 mCD. Consent is being sought for capital dredging to lower the Design Dredge Level for Wharf 7 as discussed in Section 3.

2.1.5 Tug Manoeuvring Area

As part of a consent application approved in 2020 (Watson, 2018), an area of capital dredging was approved as part of the Wharf 7 reconstruction, to an agreed level of -8.1 mCD.

2.2 Summary

Based on the available historical and recently approved capital and maintenance dredge level information, Worley prepared the information presented in Table 2-1, and Figure 2-1 to Figure 2-3 for the existing maintenance dredging application submitted in early 2020 (Worley, 2020). Worley notes

- The proposed dredge levels will not impact the existing structures
- Figure 2-1 to Figure 2-3 show the area to the toe of the dredging, and for information only include a dashed line to indicate the top of batter. During maintenance dredging, only areas within the toe are dredged.

As noted in Section 1.1, previous consents applied for by EPL have included either the Declared or Design Dredge Level. For this consent, all levels have been provided as the Design Dredge Level.

*Table 2-1 - Summary of **Existing** Maintenance Consent Application Dredge Areas and Levels*

Port Area	Existing Maintenance (Design) Dredge Level (m below chart datum)	Area (ha)
Port Navigation Channel (PNC)	-11.0 mCD	15.5
Wharf 8 Berth Pocket	-10.9 mCD	1.3
Wharf 7 Berth Pocket	-9.7 mCD	1.2
Deep Vessel Turning Basin (VTB)	-10.5 mCD	3.5
Shallow Vessel Turning Basin (VTB)	-7.5mCD	1.6
Tug Manoeuvring Area	-8.1 mCD	0.2
	Total Area	**23.3**

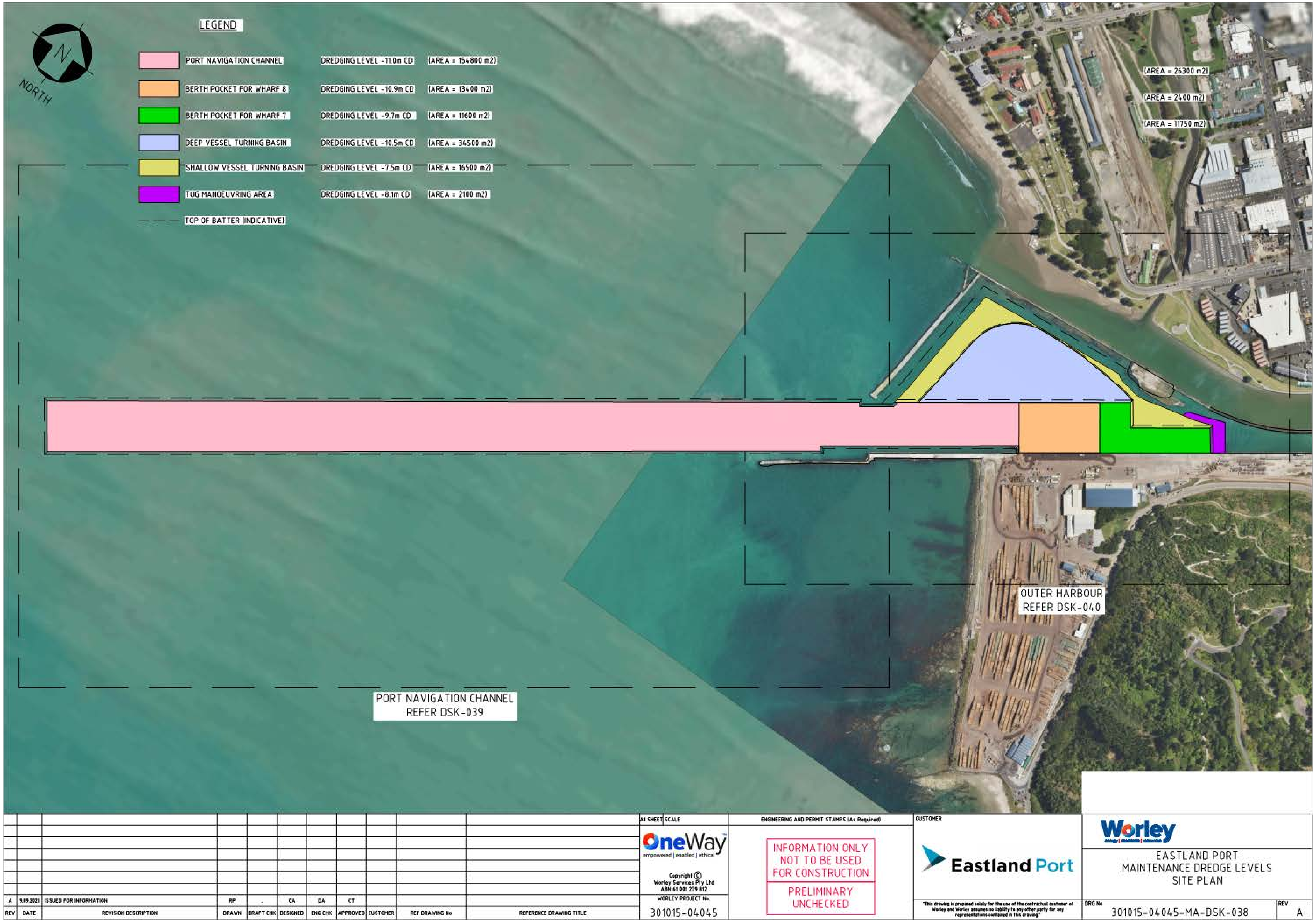

Figure 2-1 – Existing Maintenance Dredge Consent Application Levels – Site Layout

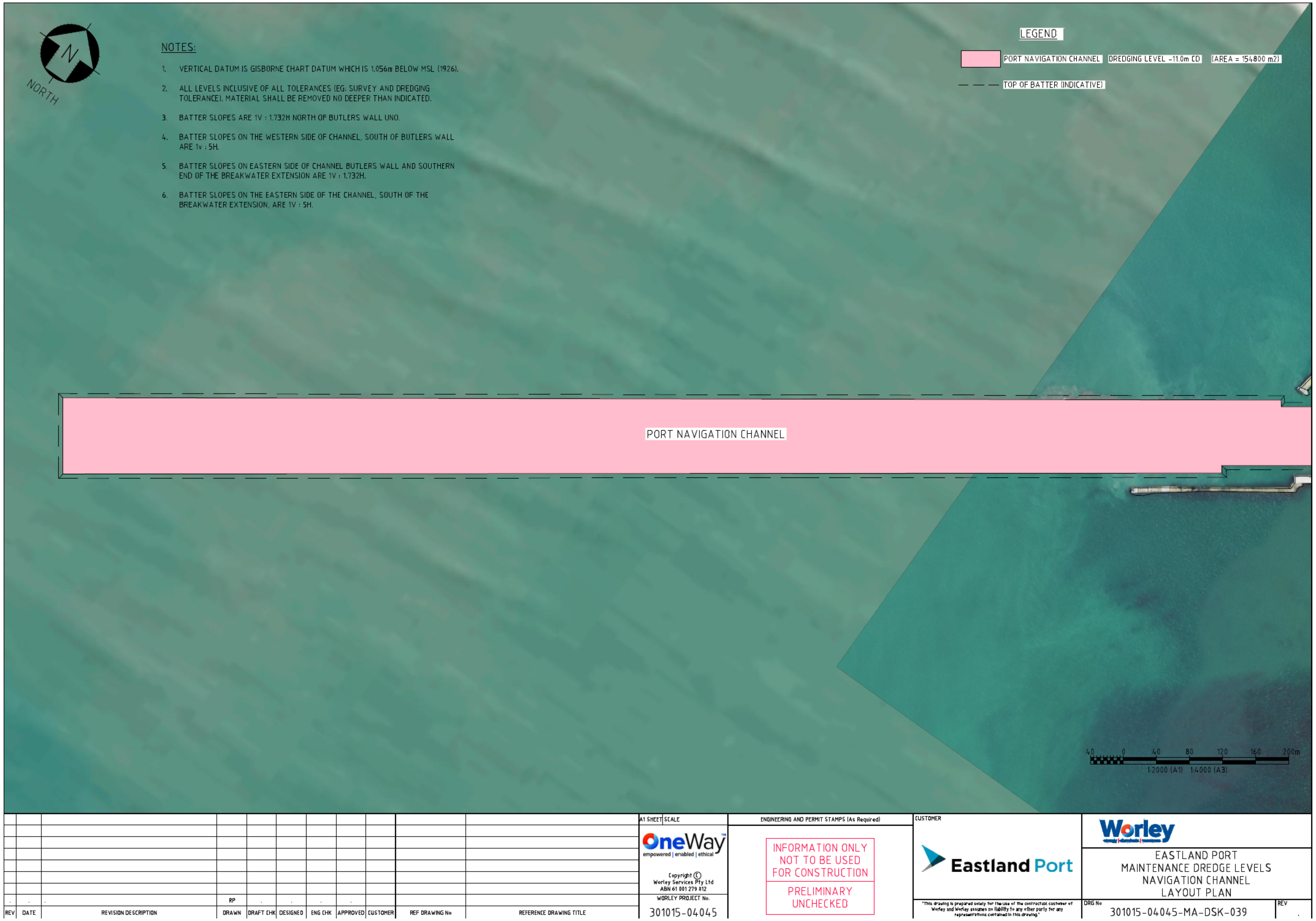

Figure 2-2 – Existing Maintenance Dredge Consent Application Levels - Channel

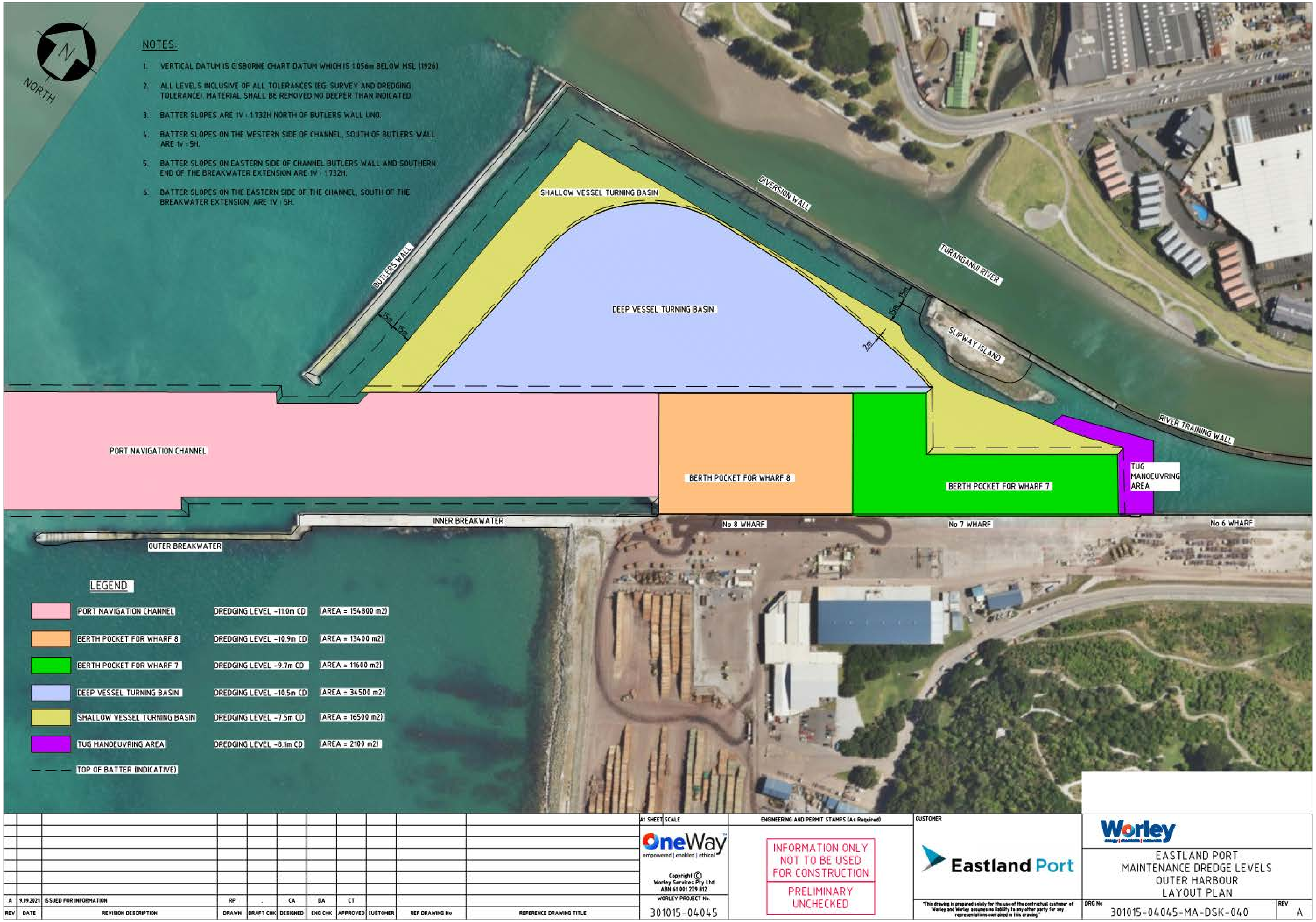

Figure 2-3 – Existing Maintenance Dredge Consent Application Levels – Outer Harbour

3. Proposed Capital Dredging Areas

As part of the changes associated with the Twin berth project, the locations of the port to be dredged, and their names, have been altered to accurately reflect their new function. The new names and the plan areas they cover are provided in Table 3-1 – Proposed New Port Areas and Depths and Figure 3-1 – New Port Location Names below.

The following key changes have been undertaken:

- The Creation of Inner and Outer Port Navigation Channels delineated by their different depths
  - Outer Port Navigation Channel
  - Inner Port Navigation Channel
- The creation of the “Low Speed Ship Manoeuvring Area” to allow a ship departing from Wharf 7 to pass a ship at Wharf 8
- The alteration of the Wharf 7 Berth pocket shape to suit the future Twin berth layout
  - Reduced to allow creation of “Low Speed Ship Manoeuvring Area”
- The alteration of the Wharf 8 berth pocket shape to suit the future Twin berth layout
  - Reduced to allow creation of “Low Speed Ship Manoeuvring Area”

Table 3-1 – Proposed New Port Areas and Depths

Port Locations	Proposed Port Area Dredge Depths (m below chart datum)	Area (ha)
Outer Port Navigation Channel	-11.6 mCD	11.8
Inner Port Navigation Channel	-11.0mCD	2.1
Low Speed Ship Manoeuvring Area	-11.0mCD	4.0
Berth Pocket – Wharf 8	-10.9mCD	0.9
Berth pocket – Wharf 7	-13.5mCD	0.9
Deep Vessel Turning Basin	-10.6mCD	2.6
Shallow Vessel Turning Basin	-7.5mCD	1.1
Tug Manoeuvring Area	-8.1mCD	0.3
Total		**23.7**

Note- The 0.4 Ha difference between here and Table 2-1 is due to the additional areas which are highlighted in the following sections. Notably 3.2.1

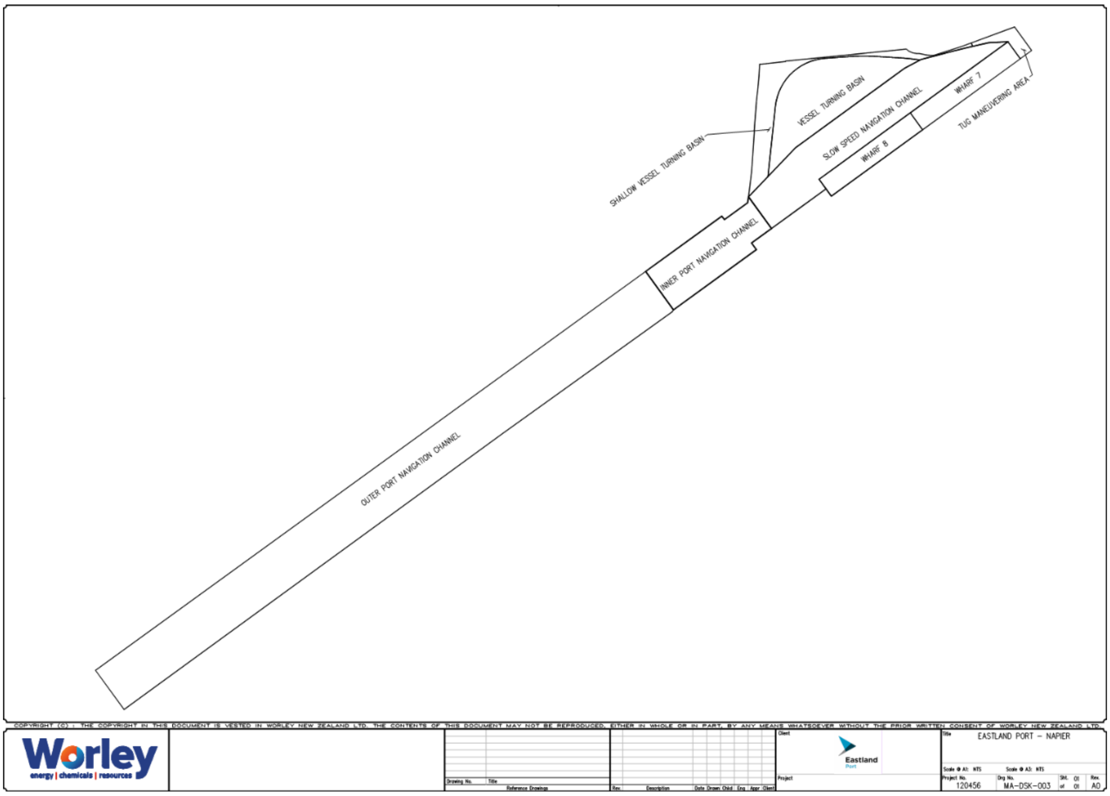

Figure 3-1 – New Port Location Names

This consent application includes the capital dredging of some locations which are covered by the existing maintenance dredge consent application (4Sight Consulting, 2020) discussed in Section 2. The locations that require capital dredging are:

- Outer Port Navigation Channel – this will require capital dredging to a Design Dredge Level of -11.6 mCD (previously -11.0 mCD)
- Low Speed Ship Manoeuvring Area - adjacent to Wharf 8 and Wharf 7 berth pockets – this will require capital dredging to a Design Dredge Level of -11.0 mCD (previously various levels), with this location extending slightly into the vessel turning basin.
- Berth pocket for Wharf 8 extension – a section will require capital dredging to a Design Dredge Level of -10.9 mCD (thin section previously undredged)
- Berth pocket for Wharf 7 – this will require capital dredging to a Design Dredge Level of -13.5 mCD (previously various levels)
- Deep Vessel Turning Basin – requires capital dredging to a Design Dredge Level of -10.6 mCD (previously -10.5mCD)
- Shallow Vessel Turning basin – the removal of some rock near the top corner to bring down the level to the current consented dredging level
- Tug Manoeuvring Area – a small section near the Slipway Island requires capital dredging to a Design Dredge Level of -8.1 mCD (section previously not capital dredged)

The method for determining these dredge levels is discussed in Sections 3.1.1 to 3.1.5 and illustrated in Figure 3-2, which in all cases includes consideration of the impact of dredging on the stability of existing structures.

All other locations within the Port would be maintained at the existing maintenance dredge levels indicated in Figure 2-1 to Figure 2-3.

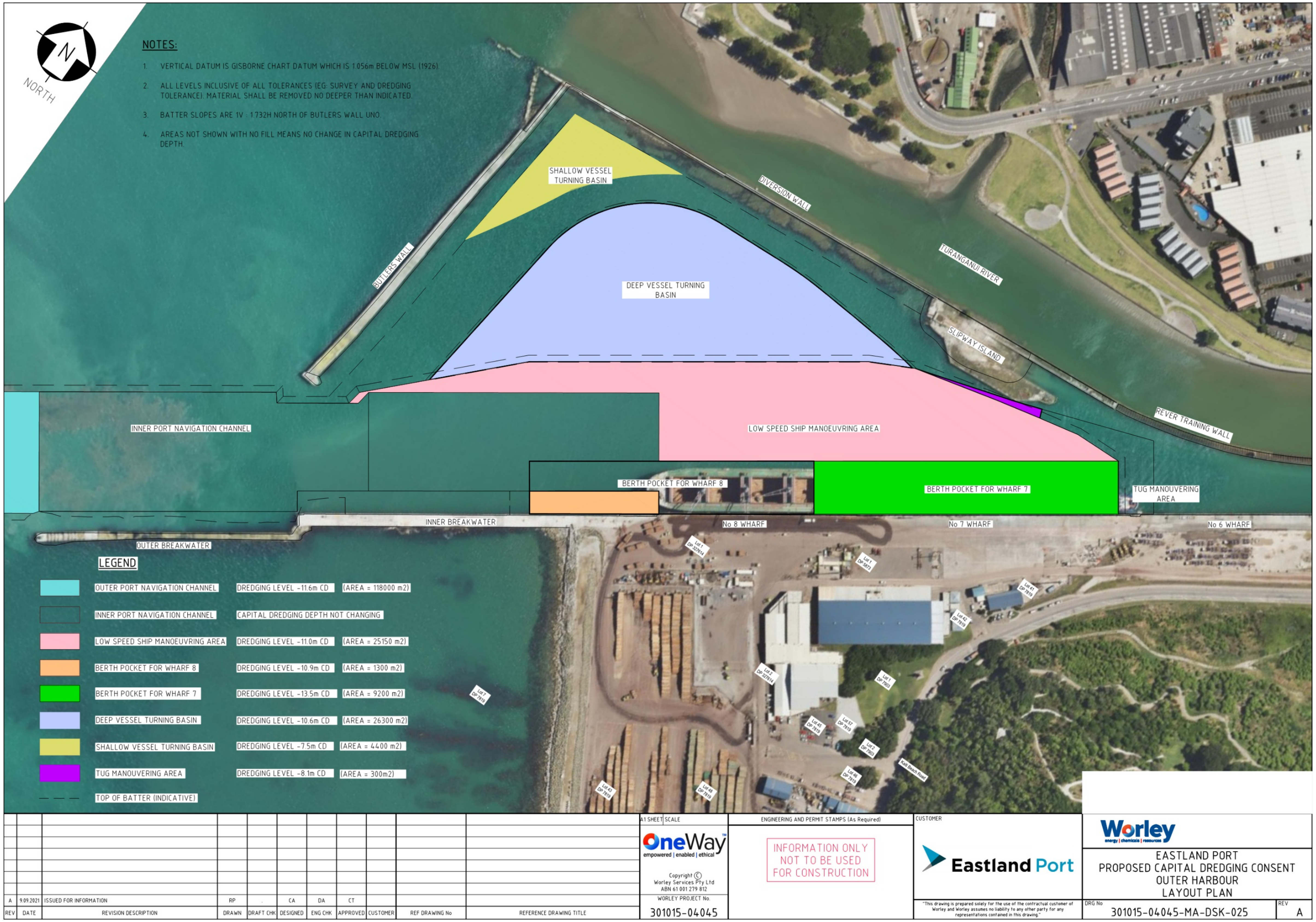

Figure 3-2 – Proposed Capital Dredge Levels – Outer Harbour

3.1 Dredge Levels and Areas

3.1.1 Outer Port Navigation Channel

The Outer section of the PNC, unprotected by the breakwater, requires a Design Dredge Level of -11.6 mCD. As ships navigating the Outer PNC are more exposed to waves and therefore can have higher vertical movements (e.g. pitch, roll, heave), an additional 0.6 m of depth is required for safe navigation, compared to the Inner PNC. The lack of this additional depth can adversely limit operations within the port. The dredge location is rectangular in shape, covering the full width of the PNC which is approximately 90 m,, and an area of approximately 12 ha, shown in Figure 3-4.

3.1.2 Low Speed Ship Manoeuvring Area

To allow deep draught ships travelling to or from Wharf 7, to pass ships at Wharf 8, an area of the port previously dredged has been redesignated as the Low Speed Ship Manoeuvring Area. Some sections of this need to be deepened. The extent of this deepening has been developed based on the results of ship simulation studies undertaken by EPL. This area is to be deepened to the same level as the Inner PNC, -11.0 mCD.

3.1.3 Vessel Turning Basin

The previous consent application for maintenance dredging provided for a maintained dredge level of -10.5 mCD to meet the future requirements of the VTB. The dredge area is shown in Figure 3-4, with the extent of this location determined based on the extents of historical dredging. The edge of the dredging will be at least 30 m from the Turanganui River Diversion Wall and at least 60 m from Butlers Wall.

Given the future vessels arriving and swinging within the harbour, it is expected that a Design Dredge Level of -10.6 mCD will be required. This is an increase of 0.1 m over the previous consent application to allow for all tolerances, including survey tolerance.

3.1.4 Wharf 8 Berth Pocket

To meet the forecast export log demand, EPL require additional log storage and stronger wharves to provide the ability to berth and load two ships at the same time. EPL have called this the Twin Berth Project.

The key objectives of the Twin Berth Project are to:

1. Increase the export capacity of the Port to cater to forecast demand
2. Provide some flexibility for possible future opportunities outside the current markets, such as woodchip and coastal container shipping, and
3. Mitigate the risk associated with damage to Wharf 8. Damage to Wharf 8 would significantly reduce the achievable throughput of the port, and subsequently adversely impact the wider Eastland community due to higher costs associated with exporting through other ports.

To achieve the Port's objectives, a second Handymax sized ship berth and increased storage capacity is required. This will involve Wharf 8 accommodating a 185 m ship, with Wharf 7 accommodating a 200 m ship, and both ships having a maximum draught of 10.8m. To accommodate this size vessel, the existing Wharf 8 needs to be extended south, with a Design Dredge Level of -10.9 mCD for the berth. It is proposed to maintain this berth pocket depth as the majority of Wharf 8 cannot accommodate a deeper dredge level (WorleyParsons, 2017).

A separate consent application is being prepared for the Wharf 8 extension – this application is only considering the dredging of a suitable berth pocket for this extension. It is noted that a new area of dredging (that has not been subject to capital dredging before) is required to accommodate the berth pocket for the proposed Wharf 8 extension. This is denoted as “5” shown in Figure 3-4, with the volume of capital dredging estimated based on the difference between the proposed dredge level and soundings from the 09/2021 hydrographic survey.

3.1.5 Wharf 7 Berth Pocket

The existing Design Dredge Level for Wharf 7 is 32’ (-9.7 mCD). Based on the Static Underkeel Clearance (SUKC) requirement in the berth pocket (0.7 m) and a sedimentation allowance (0.4 m) this would indicate that the maximum ship draught for the wharf is 8.7 m. The log ships visiting tend to have a maximum draught between 9.7 m and 10.8 m. This means the berth is not capable of handling the current log ship traffic without deepening, which will be difficult to achieve on the existing structure.

This area of approximately 9,000 m^2 is located directly adjacent to Wharf 7, which is to be redeveloped in accordance with the December 2020 resource consent decisions (Watson, 2018). It is approximately 230 m long by 40 m wide. To achieve the Port’s objectives of increased export capacity and future opportunities, it is proposed to accommodate ships of up to 200 m at Berth 7, hence requiring a 230 m long berth pocket. However, due to other factors such as the condition of the breakwaters limiting the Inner PNC depth, these would be draught limited to the same draught as the 185 m ships.

The berth pocket level is affected by several factors that are all linked, being

- Ship draught at departure
- Ship heave
- Under keel clearance
- Sedimentation allowance.

EPL has a Standard Operating Procedure (SOP) that identifies the parameters that the port finds acceptable for the berthing of ships in various weather conditions. Based on this, the acceptable additional clearance that needs to be allowed under a ship is 0.7 m in the berth pocket.

As the port is to have a design life of at least 50 years and the acceptable risks associated with ships (under keel clearance) may change, it is prudent to design the wharf structures to a maximum predictable berth pocket level. EPL engaged Worley (formerly WorleyParsons, (WorleyParsons, 2018)) to undertake a design berth pocket level assessment, taking into account factors affecting ship heave such as infragravity waves, which concluded that the maximum likely design berth pocket level (for fully loaded ships with a draught of 10.8 m) should be -12.5 mCD. Based on analysing the exceedance probability of the various factors, this allows for the berth pocket to be too shallow for only an average of 1 hour every 6 months for a ship with a draught of 10.8 m (Figure 3-3). That is once every 6 months laden ships will not be able to stay at the berth due to insufficient underkeel clearance, which EPL has determined is acceptable. To allow for the installation of future scour protection in the berth pocket and maintain the declared depth at the berth pocket of -12.5 mCD, a dredge depth of -13.5 mCD has been designed for the berth pocket.

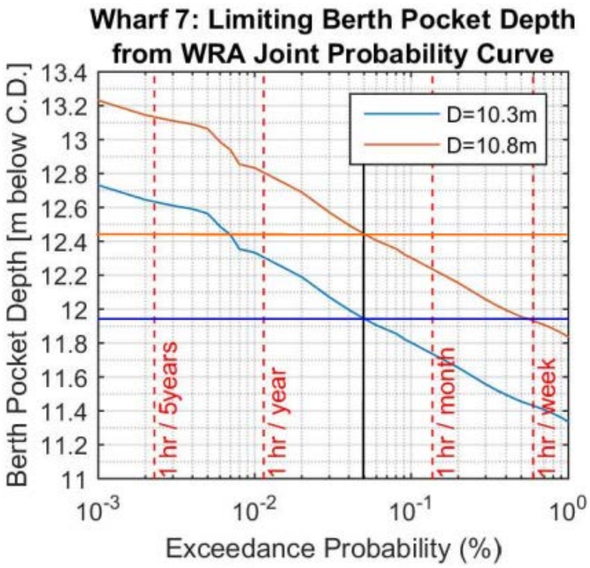

Figure 3-3 – Berth pocket depth (m below CD) vs exceedance probability (WorleyParsons, 2018)

3.1.6 Tug Manoeuvring area

A small section of dredging is required to allow service vessels such as tugs to assist ships transiting to and from Berth 7. This area is proposed to be dredged to –8.1 mCD, the same as the rest of the Tug Manoeuvring Area (2.1.5).

3.2 Summary

Based on the available historical and recently approved capital and maintenance dredge level information, Worley has prepared the information presented in Figure 3-4 and Table 3-2. Worley notes

- Figure 3-4 shows the area to the toe of the dredging, and for information only includes a dashed line to indicate the top of batter.
- As noted in Section 1.1, previous consents applied for by EPL have included either the Declared or Design Dredge Level. For this consent, all levels have been provided as the Design Dredge Level.

3.2.1 Dredge Volumes

Worley has estimated the capital dredge volumes based on the difference between the recently applied for maintenance dredge levels and areas (Table 2-1, Figure 2-1 to Figure 2-3) and the proposed capital dredging levels and areas. Worley also calculated the volumes between the interpreted rock surface from (Marine & Earth Sciences Pty Ltd (MES), 2016) and this capital dredging consent. This was used to estimate the volume of rock to be dredged from various areas and therefore the split between rock and sediment. (Table 3-2)

For the southern extension of the Wharf 8 berth pocket, the volume has been estimated based on the difference between the proposed capital dredging level and the 09/2021 hydrographic survey.

The areas where capital dredging would be required (beyond the Existing / Maintenance Dredge Levels) are illustrated in Figure 3-4. With the exception of areas 6 and 7, all other areas have previously been capital dredged, and presently have maintenance dredging activity undertaken within them.

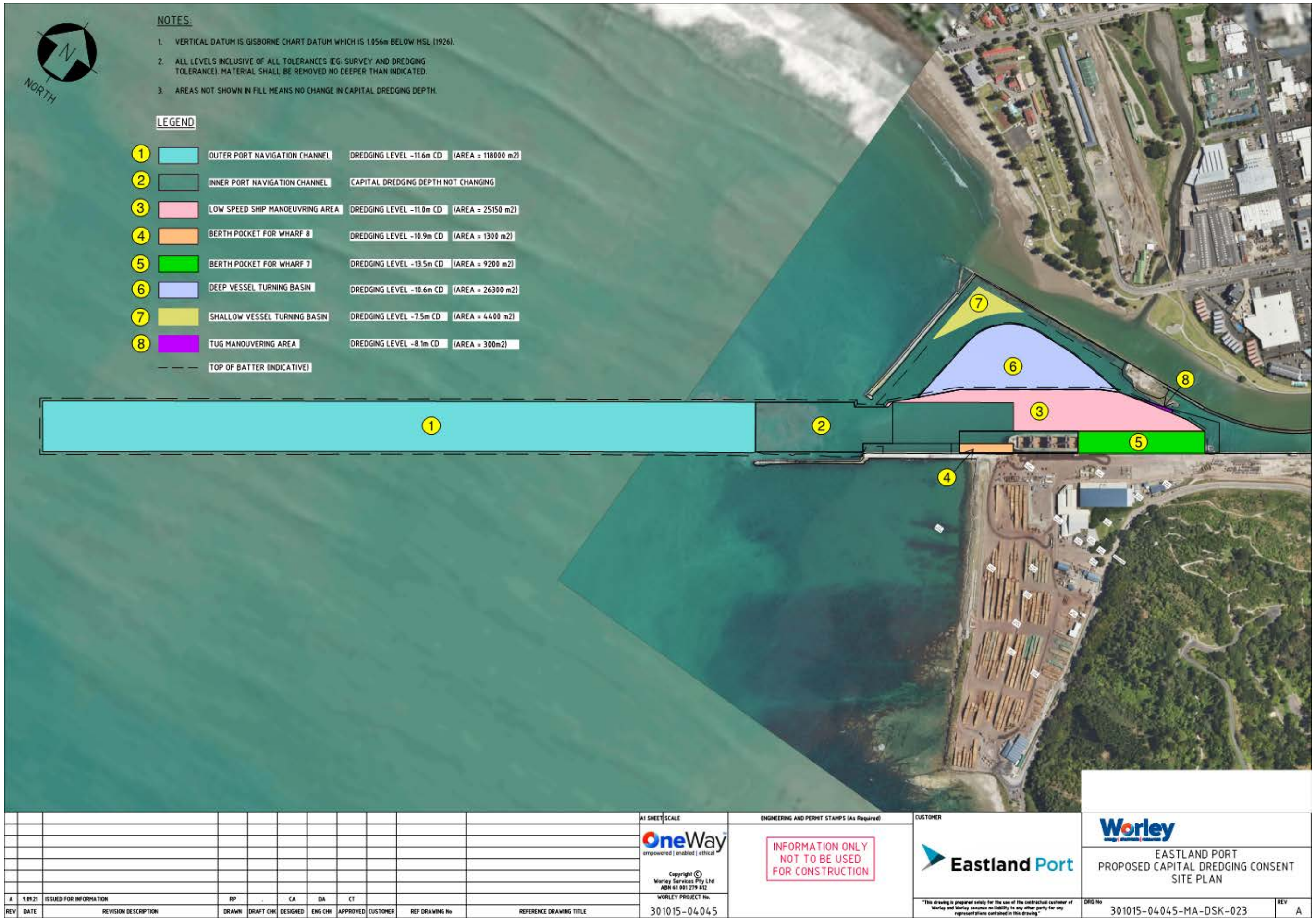

Figure 3-4 – Locations where capital dredging will be required (Locations 1 to 7 are referenced in Table 3-2)

Table 3-2 – Locations where capital dredging is required (refer Figure 3-3 for locations)

Port Location	Proposed Capital (Design) Dredge Level (m below chart datum)	Total Volume of capital dredging (m3)	Volume of Sediment (m3)	Volume of Rock (m3)	Capital Dredging Area (m2)
1. Outer Port Navigation Channel	-11.6 mCD	70,500	68,400	2,100	118,000
2. Inner Port Navigation Channel	-11.0mCD	0	0	0	0
3. Low Speed Ship Manoeuvring Area	-11.0 mCD	25,800	22,500	3,300	25,150
4. Wharf 8*	-10.9 mCD	4,700	4,400	300	1,300
5. Wharf 7	-13.5 mCD	33,600	22,300	11,300	9,200
6. Deep Turning Basin	-10.6 mCD	2,700	0	2,700	26,300
7. Shallow Turning Basin #	-7.5 mCD	2,700	0	2,700	4,400
8. Tug Manoeuvring*	-8.1 mCD	600	0	600	300
TOTAL^		**140,600**	**117,600**	**23,000**	**184,650**

*Locations 4 and 8 are new areas of capital dredging that have never been dredged, volume of capital dredging estimated based on difference between dredge level and 09/2021 hydrographic survey.
^Total area only includes areas identified above, that will require capital dredging.
There are areas in the corner of the shallow turning basin and perimeters of the shallow turning basin that are shown as rock on the interpreted rock surface from the survey undertaken by Marine & Earth Sciences Pty Ltd. This consent is not looking to alter the consented level in these areas but to permit capital dredging of this previously consented area.

Figure 3-5 shows the annual total dredge volumes, volumes using EPL's dredge, the Pukunui, and the average annual dredge volume (72,800 m^3) over the 17-year period from 2003 - 2019. This figure shows that the inter-annual rate varies significantly, from a minimum of 16,500 m^3 in 2005 to a maximum of 138,200 m3 in 2011, with some period of years being consistently higher than average (e.g. 2009-2014) while other periods are lower than, or close to average (e.g. 2004-2008). This variation is predominantly due to the varying amounts of deposition that occurs due to climatic effects (e.g. rainfall, wave events etc.).

With the estimated total volume of capital dredging required being approximately 140,000 m^3 (Table 3-2), this is equivalent to the upper range of EPL's average annual maintenance dredging volume. It is expected that the capital dredging can take place largely within EPL's typical annual window for maintenance dredging, and sediments will be able to use the same equipment.

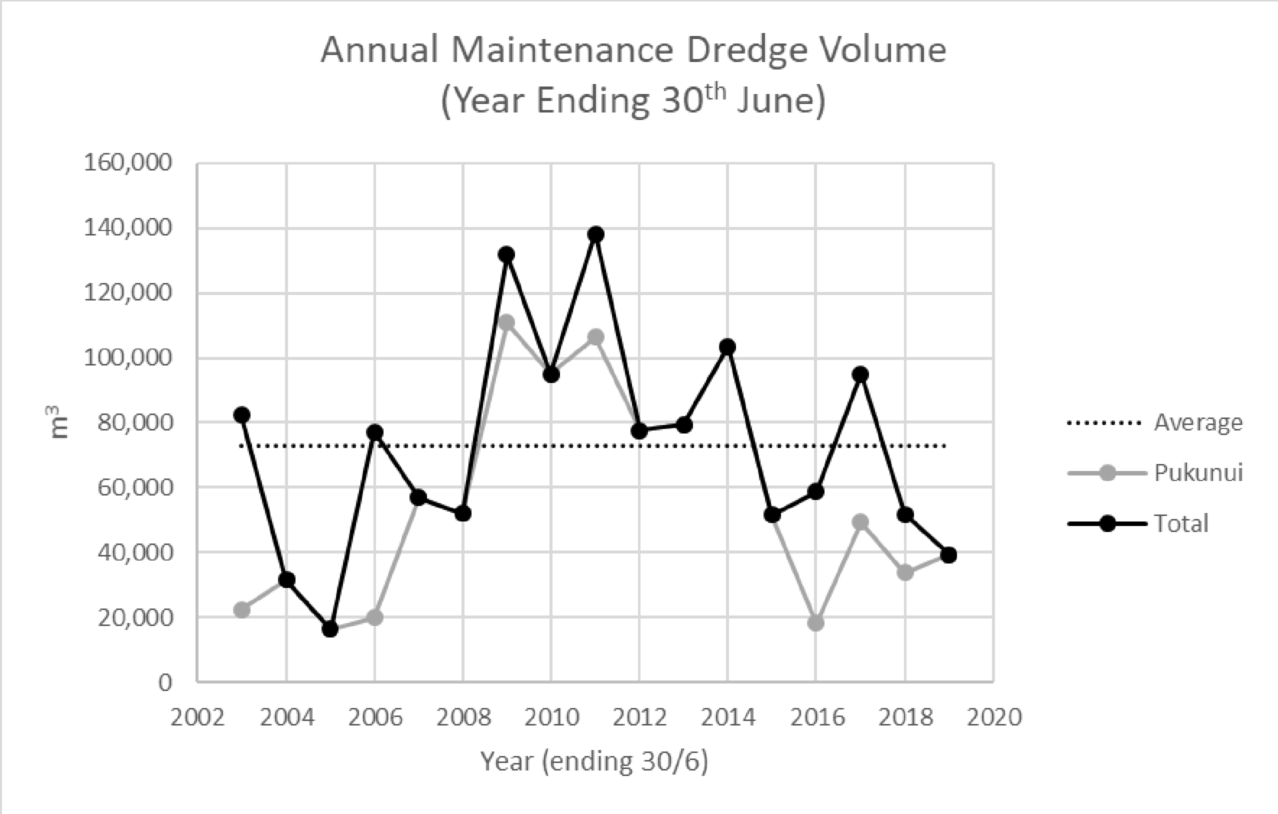

Figure 3-5 – Annual Maintenance Dredge Volumes for Eastland Port

4. Future Maintenance Dredging

4.1 Future Maintenance Dredging

The proposed future maintenance dredging locations and levels are illustrated in Figure 4-1 to Figure 4-3, and compared with the existing maintenance dredge levels over the same areas in Table 4-1, noting that the boundaries of the defined locations are proposed to be adjusted when compared to their existing boundaries.

Table 4-1 - Summary of Previous and Proposed Maintenance Dredge Areas and Levels

Port Area	Existing Maintenance (Design) Dredge Level (m below chart datum)	Proposed Maintenance (Design) Dredge Level (m below chart datum)	Proposed Area (ha)
Outer Port Navigation Channel	-11.0 mCD	-11.6 mCD	11.8
Inner Port Navigation Channel	-11.0 mCD	-11.0 mCD	2.1
Low Speed Ship Manoeuvring area	-10.5, -7.5, -11.0, -10.9 & -9.7 mCD	-11.0 mCD	4.0
Berth Pocket – Wharf 8	-10.9 mCD	-10.9 mCD	0.9
Wharf 7 Berth Pocket – Wharf 7	-9.7 mCD	-13.5 mCD	0.9
Wharf 7 Berth Pocket batter[1]	-9.7 mCD to existing surrounding bed level	-9.7 mCD to existing surrounding bed level	0.3
Deep Vessel Turning Basin	-10.5mCD	-10.6mCD	2.6
Shallow Vessel Turning Basin	-7.5 mCD	-7.5 mCD	1.1
Vessel Turning Basin Batter[1]			1
Tug Manoeuvring Area	-8.1 mCD	-8.1 mCD	0.3
	Total Area		**25.0**

1. Batter areas are approximate only and extend from existing seabed to proposed dredge level.

4.2 Dredge Volumes

For the purposes of this report, Worley has relied on two main sources of information for dredge volumes. For consistency with the Maintenance Dredging Liaison Group Annual Report 2019 (MDLGAR 2019) (Eastland Port, 2019), annual periods cover the period from the 1st July to 30th June.

- For the period 1st July 2013 to 30th June 2019 (i.e. years 2015, 2016, 2017, 2018 and 2019), daily dredge logs provided by EPL have been used.
- For period 1st July 2002 to 30th June 2013, annual dredge volumes included within the MDLGAR 2019 have been used as daily dredge logs were not available.

Figure 3-5 shows the annual total dredge volumes, volumes using EPL's dredge, the Pukunui, and the average annual dredge volume (72,800 m^3) over the 17-year period, with the quantity varying from a minimum of 16,500 m^3 in 2005 to a maximum of 138,200 m^3 in 2011.

It is expected that the long-term average for the port will continue to be around 70-80,000 m^3. However, to allow for annual spikes in deposition, caused by the inter-annual variability of storm events, and some localised "catch-up" dredging of the VTB to bring it back to its capital dredged level, an annual rate of up to 140,000 m^3 is recommended for this consent.

4.3 Increased Maintenance Dredge Area

Of the proposed area to have maintenance dredging undertaken, only 1,250 m^2 (Area 4, Figure 3-4 and Table 3-2) or 0.6% of the total area, is not presently the subject of maintained dredging.

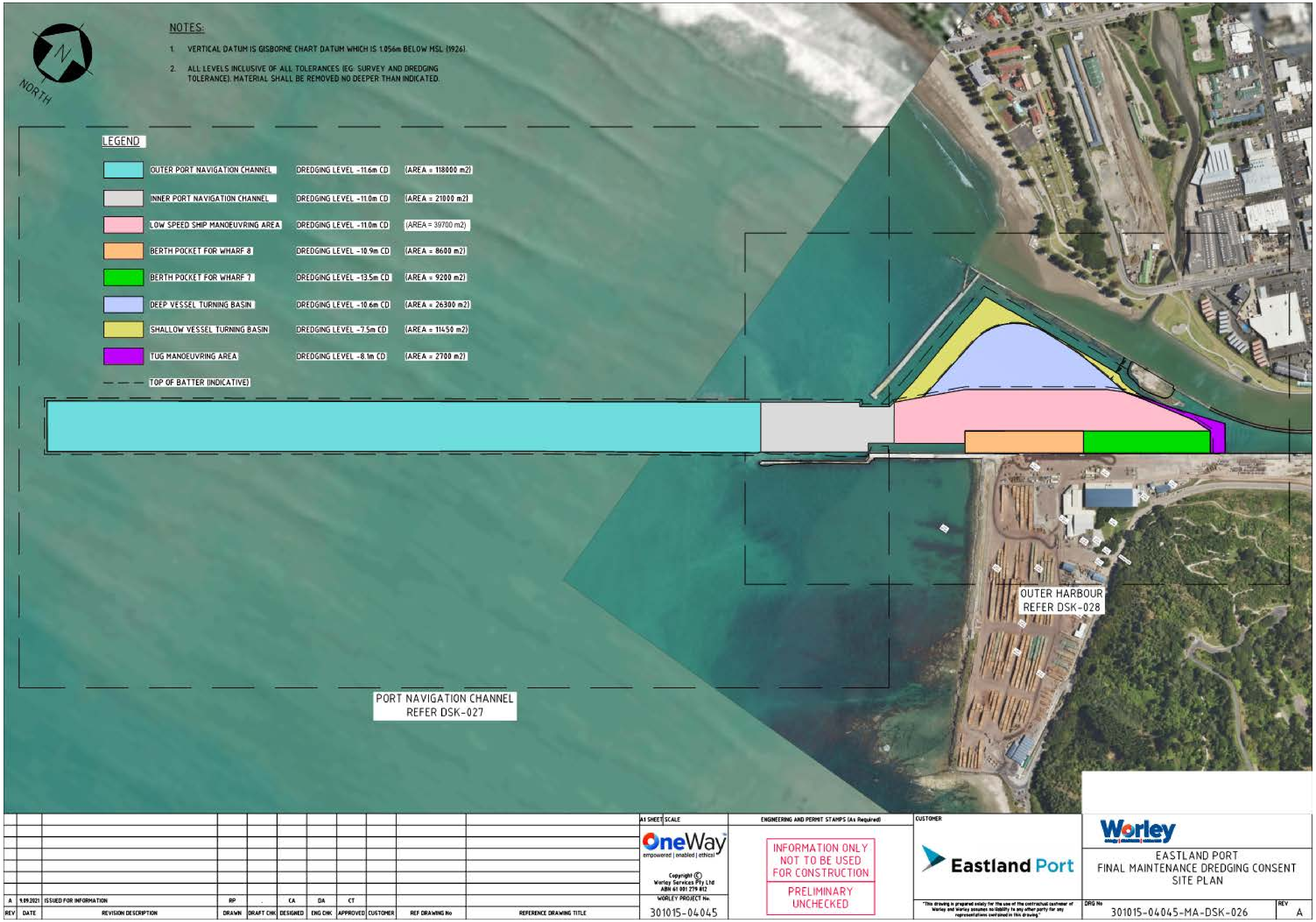

Figure 4-1 - Proposed Maintenance Dredge Levels – Site Layout

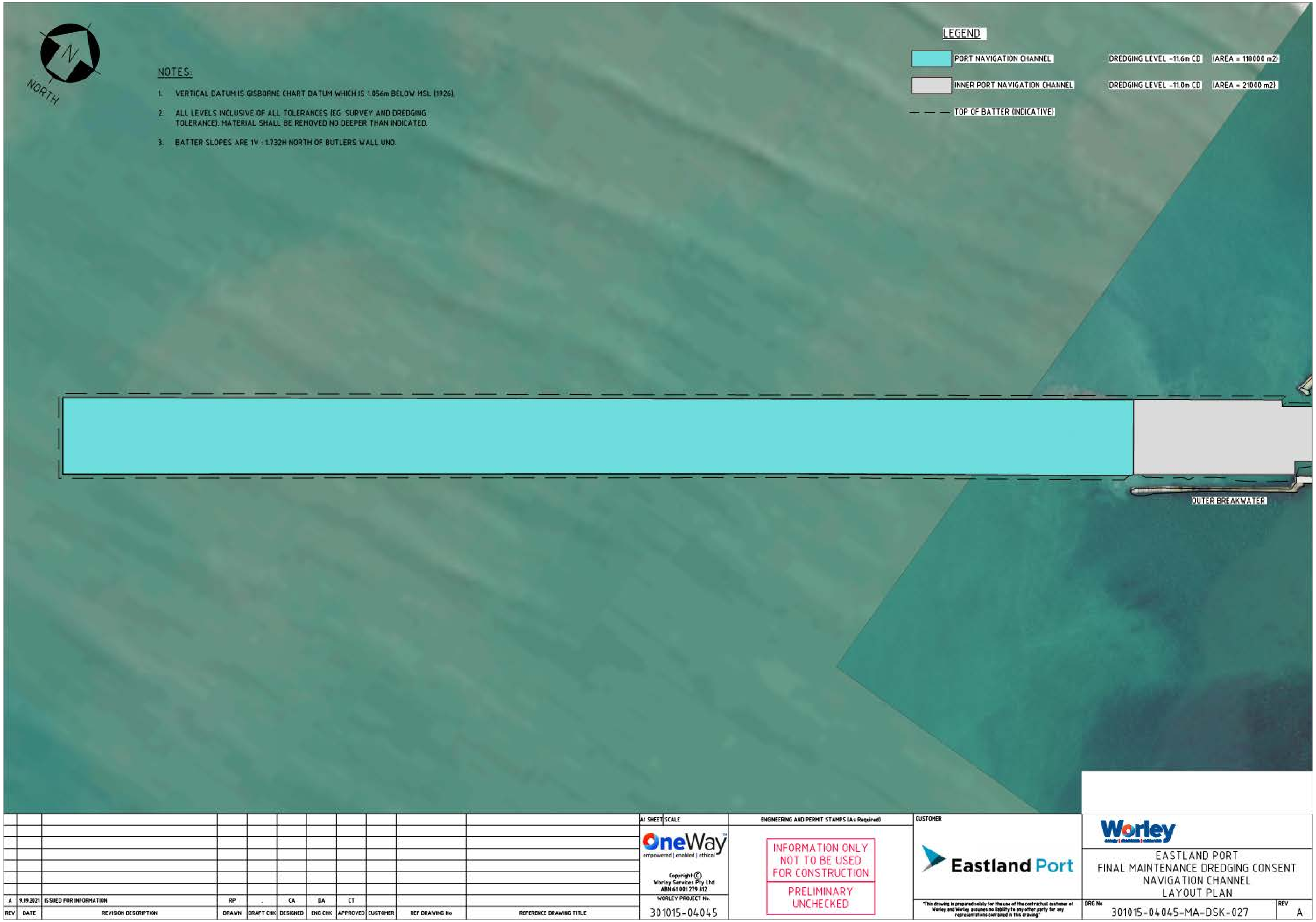

Figure 4-2 – Proposed Maintenance Dredge Level – Channel

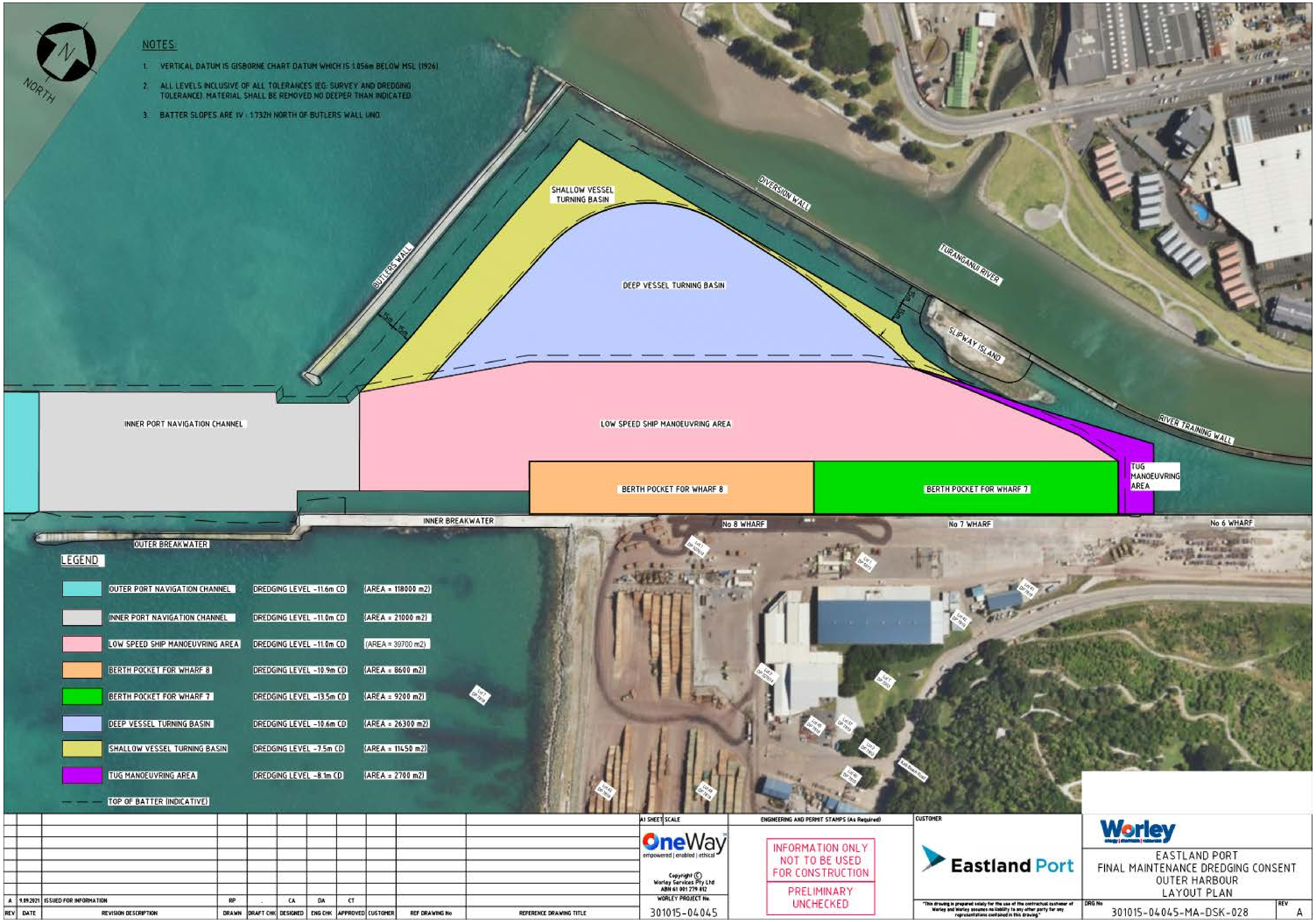

Figure 4-3 – Proposed Maintenance Dredge Level – Outer Harbour (red outline is existing maintenance dredge consent areas)

4.4 Dredging Frequency

To estimate future maintenance dredging frequency, historical data on number of days of dredging provides reasonable guidance. Table 4-2 and Figure 4-4 shows the number of annual days of dredging over the period that daily dredging logs were available for this report. Like the annual dredging volumes, the number of days of dredging varies significantly from 51 in 2016 up to 134 in 2014, although the average number of days is approximately 95 days. The shape of the graph is similar to the total dredging volumes, however there is some variation due to the use of higher productivity dredgers (see Section 5.2) in some years reducing the number of days required to remove the required volume of material (e.g. 2016, 2017 and 2018).

Table 4-2 - Number of Days of Dredging

Year	# Days Dredging
2014	134
2015	77
2016	51
2017	123
2018	87
2019	99

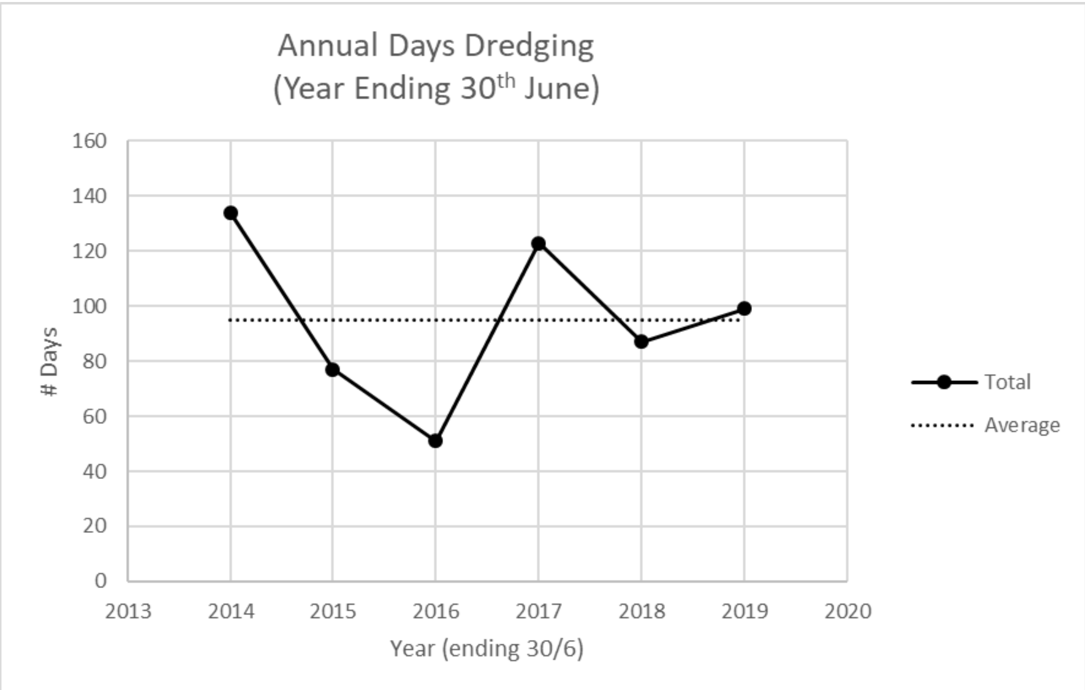

Figure 4-4 – Annual Maintenance Dredging Days for Eastland Port

Figure 4-5 shows the average, minimum and maximum number of days of dredging/month over the 6 years of available data. This shows that for a single month (e.g. January, February, March), the number of days of dredging can vary from 0 to 29 days.

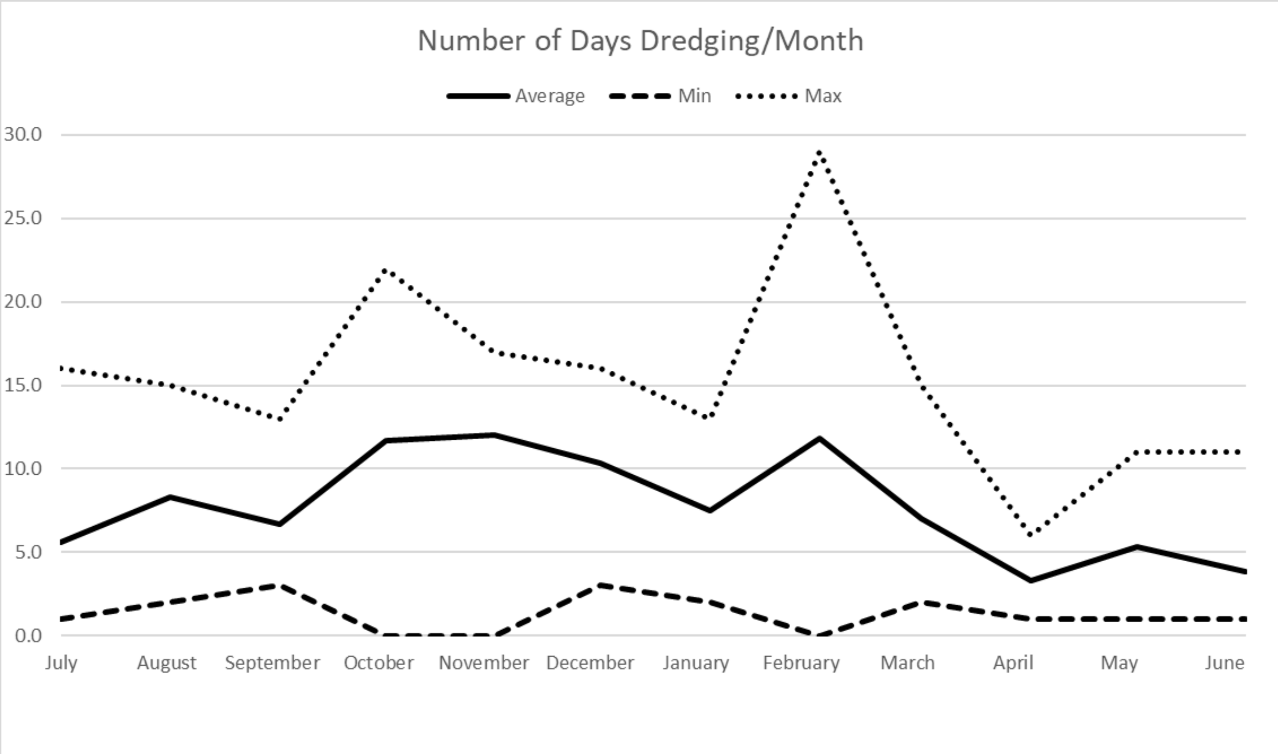

Figure 4-5 – Number of Days of Dredging

4.5 Sedimentation 'Hot-Spots'

Figure 4-6 shows the average dredge volumes for the 7 locations identified in the daily dredging logs for the period 2014-2019. This graph shows that the Inner Channel has the greatest levels of sedimentation, with over 50% of the total volume, and the next greatest attracting less than 30% of the volume of the Inner Channel.

Figure 4-7 shows the definition of the Inner, Centre and Outer Channel where most of the sedimentation occurs.

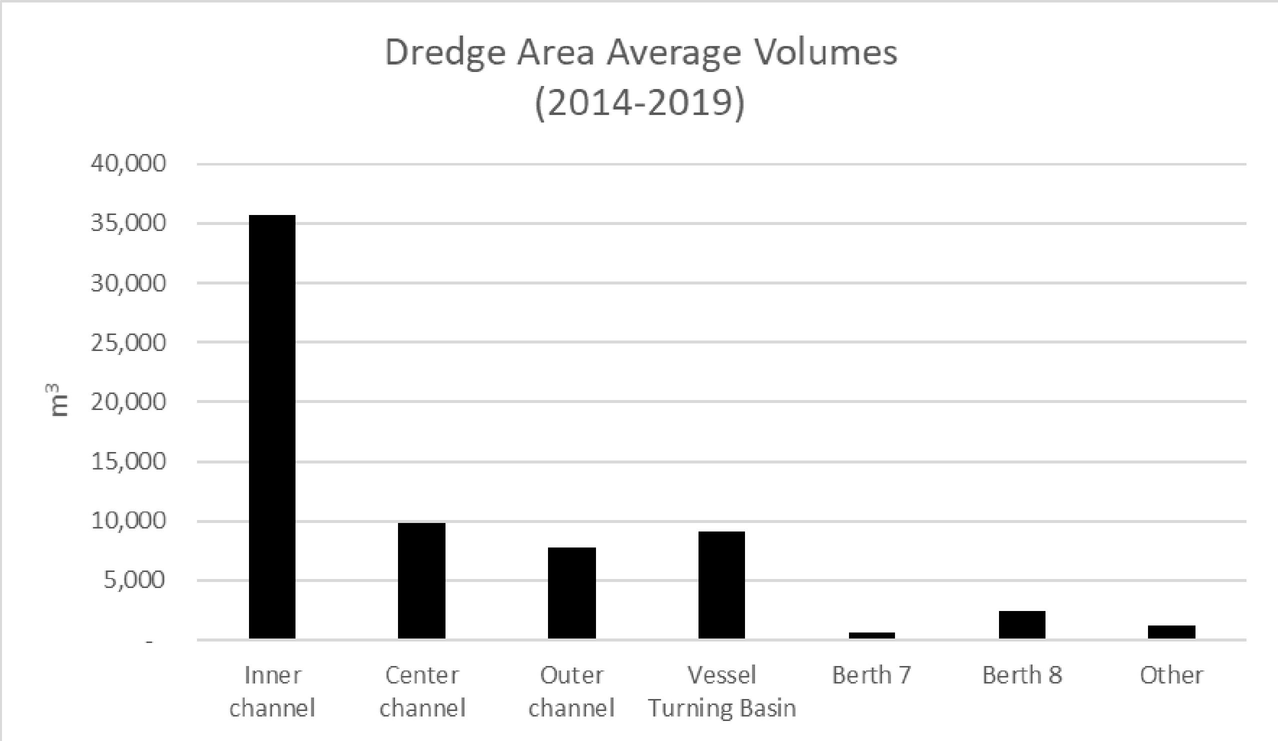

Figure 4-6 – Dredging Area Average Volume (2014-2019)

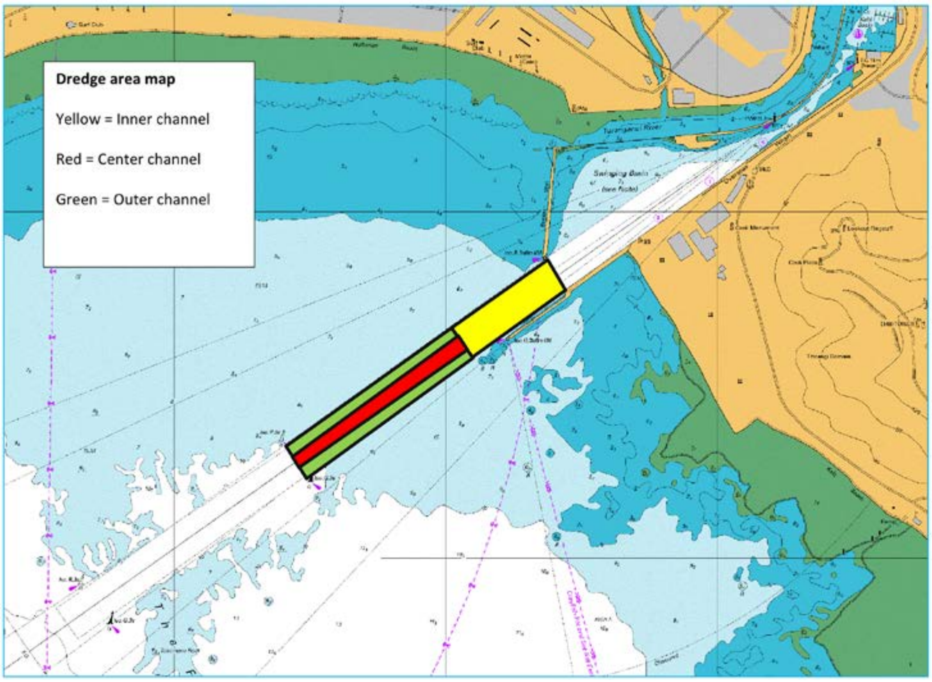

Figure 4-7 – Channel Dredge Areas (email Bayley M. to Aubourg D., 21/1/2020)

4.6 Dredging January 2020 onwards

At the end of 2019 EPL retired the dredge the Pukunui and moved to a campaign dredging strategy to do their maintenance dredging on a targeted campaign basis. This has resulted in the area data captured changing slightly which means it no longer lines up with the source data in the graphs in Figure 3-5 and Figure 4-6. Moving forward and on the completion of the capital dredging for the Twin Berth Project, EPL will be capturing the data in relation to the areas as outlined in this report and in the future new graphs generated to reflect the new situation.

Through the information supplied by EPL it can be seen the Albatross dredged approximately 26,700m^3 over 7 days in September 2020 and 43,200m^3 over 13 days in the first half of 2021. This amounts to approximately 70,000m^3 of dredging in that year (July 2020 – June 2021). From the graphs in Figure 3-5 and Figure 4-4 it can be seen that this amount is close to the average dredging volume for the port but a significant reduction in the days of dredging per year.

5. Dredge Material

5.1 Capital Dredge Areas

Information on the material being dredged is documented in a combined site-wide historical geotechnical data – geotechnical factual report (Tonkin & Taylor, 2019). A geophysical survey undertaken by Marine & Earth Sciences Pty Ltd (Marine & Earth Sciences Pty Ltd (MES), 2016) provides an interpretation of the rock levels within the proposed locations for capital dredging. In summary, the survey interpreted the following materials to be present within the proposed capital dredging areas:

- Within the Outer Port Navigation Channel, there are areas where the rock levels are interpreted to be above -12 mCD, with the thickness of unconsolidated material interpreted to be less than 0.5 m shown in red in Figure 5-1. As the dredge level is proposed to be -11.6 mCD in the outer PNC, which is 0.6 m below the existing maintenance dredge level, there is a risk of encountering bedrock during dredging at the outer PNC.
- Within the berthing and turning basin, the predominant character of the subsurface material is interpreted to be clay and silt. At the Wharf 8 Berth Pocket and in the adjacent Low Speed Ship Manoeuvring Area, the thickness of unconsolidated soft material is interpreted to be between 2 – 4 m, with rock levels interpreted to be approximately -12 mCD (proposed dredge level is -10.9 and -11.0 mCD). However, the Wharf 8 extension area is likely to require some rock dredging, with rock levels at the western end of the berth pocket (as measured by the dredge survey) approximately -10.7 mCD, and potentially higher closer to the breakwater.
- Within the Vessel Turning Basin, the thickness of unconsolidated material is interpreted to be between 2 – 3 m and rock levels are interpreted to be around -10 mCD (proposed dredge level is -10.6 mCD).
- At the Wharf 7 Berth Pocket, the thickness of unconsolidated material is interpreted to be 2 – 3 m, and rock levels are interpreted to be between -10 mCD and -12 mCD (proposed dredge level is -13.5 mCD).
- Rock is interpreted to be slightly weathered mudstone or unweathered siltstone, based on data from adjacent boreholes at Wharf 7.

The interpreted thickness of unconsolidated material at the berth, overlaid onto the proposed capital dredging areas, is shown in Figure 5-1, with the interpreted rock levels shown in Figure 5-2. Superimposed on Figure 5-2 is a rock level obtained from a survey undertaken using the Heron GPK dredge on 11 December 2017. It can be seen that, particularly at the Wharf 7 berth pocket, parts of the Wharf 8 berth pocket and adjacent Low Speed Ship Manoeuvring Area, rock levels are interpreted to be above -12 mCD. This indicated that dredging of rock material will be required to achieve the proposed capital dredge levels. Dredging of rock material may also be required in the Outer PNC.

For the overlying unconsolidated material, the material is interpreted to be predominantly silt and clay, with some coarser sands and silts that may be related to propeller wash flushing fines from this area.

The overlying unconsolidated material in the inner basin, channel entrance and outside the port has been reported on in a number of documents, including reports by Metocean Solutions (Metocean Solutions Ltd, 2018), 4Sight (4Sight Consulting, 2019) and EPL (Eastland Port, 2019). In summary these reports show that

- Material within the port is predominantly silt, while material in the channel is predominantly sand. Table 5-1 is reproduced from data in (Metocean Solutions Ltd, 2018)
- Contaminants are below required sediment quality limits (4Sight Consulting, 2019).

Table 5-1 - Surficial sediment distribution within the port basin and outer bay (Metocean Solutions Ltd, 2018)

	Percentage (%)	**Median Diameter d_{50}** [µm]
Inner Basin		
Sand	20%	180
Silt	60%	20
Clay	20%	2
Channel Entrance		
Sand	80%	170
Silt	10%	20
Clay	10%	2
Outside of Port		
Sand	70%	110
Silt	20%	30
Clay	10%	2

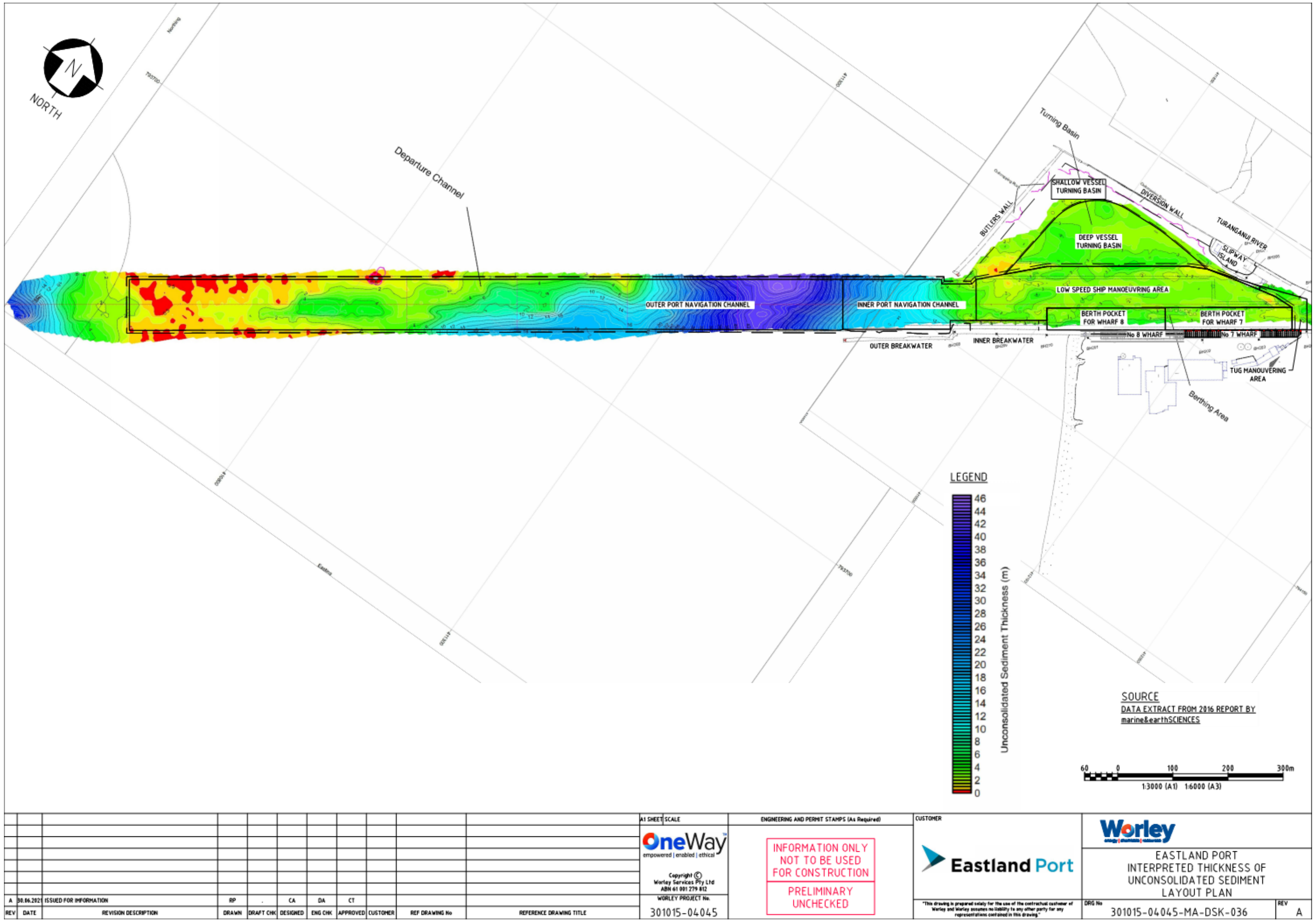

Figure 5-1 – Interpreted thickness of unconsolidated sediment with capital dredge areas and levels overlaid (Marine & Earth Sciences Pty Ltd (MES), 2016)

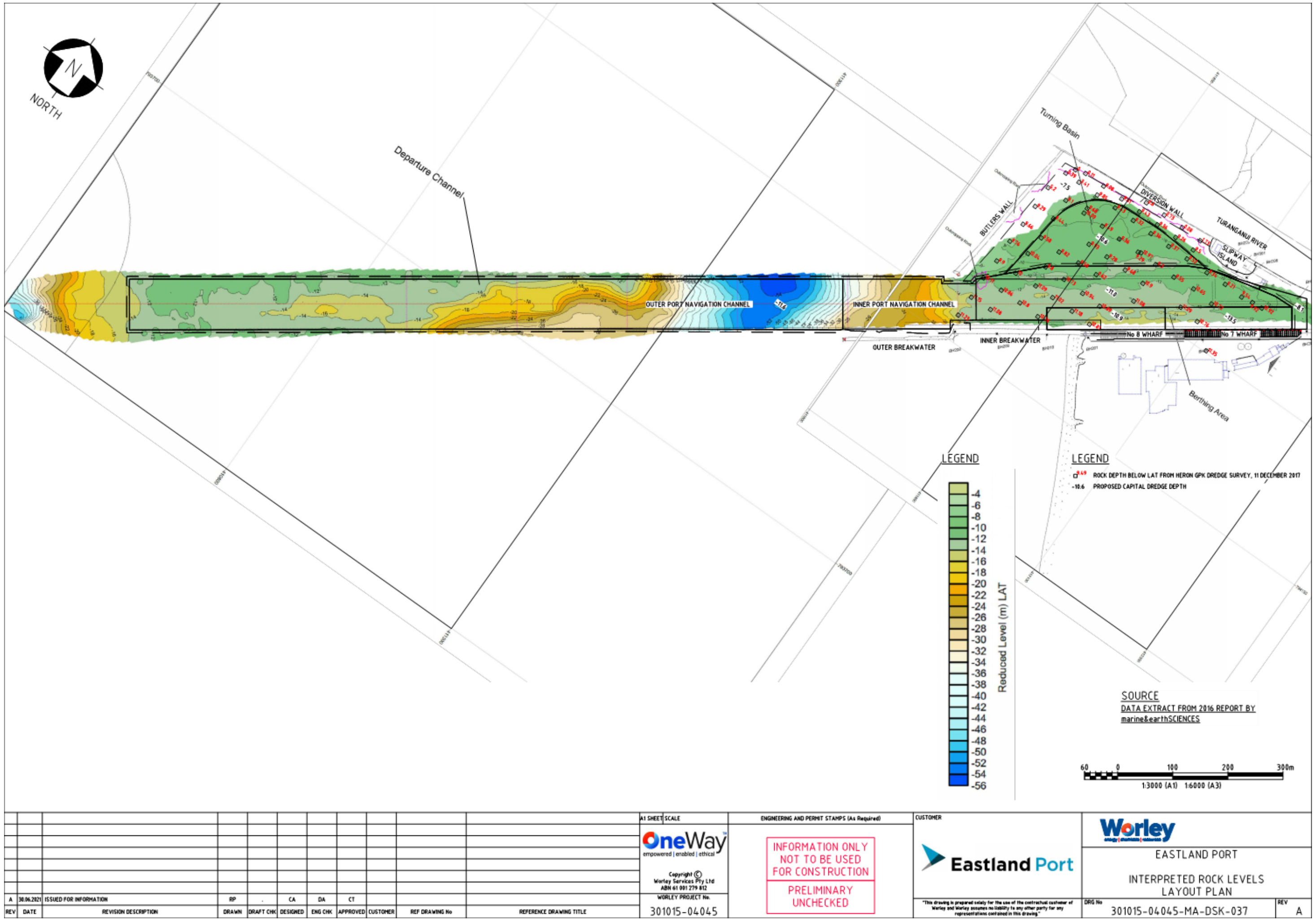

Figure 5-2 – Interpreted rock levels from geophysical survey (Marine & Earth Sciences Pty Ltd (MES), 2016) with proposed capital dredge areas and levels (black) and rock levels (red) from dredging survey (2017).

5.2 Maintenance Dredge Areas

For future maintenance dredging, material to be dredged will comprise unconsolidated silt and sand that is transported into the dredged areas from adjacent areas by propeller wash, currents and waves. Historically, material within the port is predominantly silt, while material in the channel is predominantly sand. Information on the material that will need to be dredged is provided in Table 5-1 (Metocean Solutions Ltd, 2018) and has contaminants below required sediment quality limits (4Sight Consulting, 2019).

6. Proposed Method of Dredging and Disposal

During the period of the consent being sought by EPL, works will need to be conducted in a similar manner to that proposed in the most recent consent application for maintenance dredging (4Sight Consulting, 2020). EPL has undertaken maintenance dredging under these and similar Coastal Permits for the last 19 years, with 75% of material being removed utilising a Trailing Suction Hopper Dredge (TSHD).

EPL have, as noted in section 4.6, moved to a targeted campaign approach to dredging where all the dredging is contracted to a dredging company using a high efficiency Trailing Suction Hopper Dredge (TSHD). It is this TSHD that will dredge the overlying unconsolidated sediments away from the wharf structures and other modified areas where possible.

Disposal of dredged material is covered by separate reports which are detailed within the AEE (4Sight Consulting, 2018)

A Backhoe Dredge (BHD) or Cutter Suction Dredge (CSD) may be used for maintenance or capital dredging within the port, particularly for removal of rock. The methodology for both types of dredging has been included below. Historically at Eastland Port, BHD has been more likely to be utilised than a CSD.

For capital dredging of the slightly weathered mudstone and siltstone rock materials within the Wharf 7 and Wharf 8 berth pockets, a backhoe dredger equipped with a hydraulic hammer, or "ripper", such as the Xcentric XR60 (https://xcentricripper.com/) or similar, may be used.

Dredging methodology for the unconsolidated materials and rock is described below.

6.1 TSHD Dredging Methodology

A THSD can be used for dredging of unconsolidated sand or silt. "In a standard design a trailing suction hopper dredger is equipped with:

- One or more suction pipes with suction mouths, called dragheads that are dragged over the seabed while dredging.
- One or more dredge pumps to suck up the loosened soil by the dragheads.
- A hold (hopper) in which the material sucked up is dumped.
- An overflow system to discharge the redundant water.
- Closable doors or valves in the hold to unload the cargo.
- Suction pipe gantries to hoist the suction pipes on board.
- An installation, called the swell compensator, to compensate for the vertical movement of the ship in relation with the sea-bed." (Vlasbom, 2007)

TSHDs operate by sailing to the site requiring dredging, reducing speed to approximately 1-3 knots, lowering the draghead to the seabed and starting the dredge pumps. The draghead disturbs the seabed material, causing it to become loosened. Combined with water, the loosened material is sucked up the suction pipes, with the resultant slurry being pumped into the hopper.

Commonly an overflow system is used where the sediment in the slurry settles quickly into the base of the hopper, leaving a relatively clean layer of water on top. If an overflow device is fitted, once the slurry reaches the entry to the overflow device, the clean water can flow out of the hopper back into the location being dredged. This leaves additional room for more slurry to enter the hopper, until the hopper becomes too full and the water at the overflow becomes unclean.

To reduce the impact of surface plumes, if finer material does not settle quickly, dredging stops once the hopper is filled with slurry and before it is allowed to overflow.

When the hopper is filled, and dredging has stopped, the suction tubes are lifted and placed on the deck of the TSHD, which then sails to the unloading area. Once on location, the doors are opened to allow the slurry to empty out.

6.2 CSD Dredging Methodology

A cutter suction dredger is a hydraulic dredger that uses centrifugal pumps with a rotating cutter head to loosen, lift and transport dredged material (https://www.iadc-dredging.com/subject/equipment/cutter-suction-dredgers/). Cutter suction dredgers may have a pontoon hull without a means of propulsion (non-propelled), or be self-propelled, sea-going specially designed vessels.

Typically, the cutter will be moored with spuds or anchors while at work and the dredging operation takes place with the cutter in a stationary position. The cutter suction dredger is equipped with a cutting device known as a cutter head. The cutter head is a mechanical rotating tool, which is able to cut hard soil or rock into fragments. It is mounted in front of the suction head and rotates along the axis of the suction pipe. This rotation separates, and excavates the soil, which is then drawn into the suction pipe as a solid/water slurry and pumped to the surface. Material dredged by a cutter is usually transported hydraulically through a pipeline, although some cutters have barge-loading facilities. Cutters are capable of dredging all types of material, including rock.

6.3 BHD Dredging Methodology

Basically, these stationary dredgers are large excavators mounted at the front of a pontoon, generally with extended booms and sticks to provide increased reach. During dredging the pontoon is anchored by three spud poles; two fixed at the front of the pontoon and one movable aft. Bucket sizes vary from a few cubic metres to 20 m^3 (Vlasbom, 2007).

During dredging, the pontoon is lifted a small distance out of the water by wires running over the spud poles. A part of the weight of the dredger is now transferred via the spuds to the bottom, resulting in sufficient anchoring to counteract the digging forces (Vlasbom, 2007).

The bucket is then lowered, similar to an excavator operating on land, dragged through the material to be dredged material until full, raised and the bucket swung around to deposit the material usually into a barge moored temporarily alongside. Once the barge is fully loaded, it is removed from the side of the pontoon, replaced with an empty barge and the full barge taken to the disposal site. It is most likely that the barges will be unpowered split hopper or bottom dumping barges, manoeuvred using a tug. Similarly, to a TSHD, the barges will be towed to the disposal site and, once in location, open the hopper/doors to allow disposal of the sediment.

Similar to TSHDs, in suitable material that settles quickly, the barge may be allowed to overflow to increase productivity. Alternatively, a silt curtain may be placed around the digging area of the dredge to reduce turbidity outside of this area and the water allowed to empty out of the bucket before the material is placed into the barge.

BHDs have a significantly lower productivity than TSHDs. However, they are more accurate and can dredge a wider range of materials, including weak rock, can remove less water during dredging, and operate in shallower water levels. Equipped with a hydraulic hammer, the BHD is able to dredge rock material.

Due to potential wharf upgrades being undertaken within the port, there is a possibility that a BHD will be operating within the port and the opportunity taken to use this dredge to assist with the removal of sediment deposited close to the existing wharves. For this reason, a BHD would likely be the method for capital dredging within the berth pockets and low speed manoeuvring areas.

6.4 Rock Dredging

Rock dredging, including at the Outer PNC, the berth pockets and turning basin, is proposed to be undertaken using a BHD, which may also need to be equipped with a hydraulic hammer, for example, the XCentric XR60 ripper. This attachment is designed for dredging rock material such as the slightly weathered mudstone and siltstone, with a strength varying between 2 MPa and 9 MPa, that is expected to underlie the soft sediments.

Rock blasting is not expected to be employed for the dredging of rock at any area within the capital dredge area. Rock blasting near the existing structures is not recommended, because vibrations from blasting may impact the structural / geotechnical capacity of the adjacent wharf structures. Blasting impact studies would need to be undertaken to investigate the feasibility of this option. For this reason, a BHD is the preferred dredging option where rock dredging will be required in front of the existing structures.

Note that the rocky material obtained from dredging is likely to be unsuitable for use in the proposed reclamation works, as the rock is likely to break down over time due to abrasion. For this reason, suitable gravel would need to be imported for the reclamation works, and dredged material would be disposed of at the Offshore Spoil Disposal Ground (OSDG).

6.5 Eastland Port Specific Dredging Methodology

It is envisaged that a BHD would be used for the capital dredging at Eastland Port, due to the proximity of the dredging to existing structures, the presence of rock material in the dredge areas and the need to achieve an accurate dredge footprint.

For capital dredging TSHD would be able to be used in the low-speed manoeuvring areas, turning basin and channel, which are further away from the wharf structures and for areas where dredge materials comprise mainly unconsolidated silts and sands, i.e. for maintenance dredging.

As mentioned previously in this report (Section 4.6) EPL have moved to a contracted maintenance dredging strategy using TSHDs that transit under their own power.

TSHDs or, in the case of a BHD, split bottom barges containing dredge spoil, will navigate to the disposal site and, once in location, open the hopper to allow disposal of the sediment.

Dredging and disposal will be conducted primarily during daylight hours although dredging will also be undertaken for 4-5 hours during night-time hours in winter. If a higher productivity dredge is required, these are likely to operate 24 hours/day.

A Safe Work Method Statement (SWMS) or similar will be prepared by EPL management and operations personnel and include a review of safety and navigation related issues. Input will also be sought from the Harbour Master. All personnel involved in dredging operations will be required to sign the SWMS before commencing work, and a copy of the SWMS shall be stored on all associated equipment.

The SWMS will be reviewed on an at least annual basis to determine whether new risks or hazards have been identified, with the updated SWMS needing to be signed by management and operations personnel, then replacing all other versions.

6.6 Disposal of Dredge Material

All dredged material is expected to be disposed of at the OSDG. Reuse of the dredged material, including rocky material, is likely to be unsuitable for use in the proposed reclamation works, as the rock is likely to break down over time due to abrasion. For this reason, suitable gravel would need to be imported for the reclamation works, and dredged material would be disposed of at the OSDG.

Dredged silt or similar material is also unsuitable to be reused within the reclamation as this may significantly increase the risk of long-term ground settlement. The silty dredged material has poor engineering qualities, with low strength, poor tillage and poor drainage characteristics. These characteristics make it unsuitable for use within the reclamation as engineered material without significant ground improvement. If dredged material were to be considered for use within the reclamation:

- relatively slow ground improvement methods such as surcharging with wick drains, would be required before the reclamation can be used for storage of logs. These methods could take a number of years before a suitable level of improvement was achieved.
- alternatively soil mixing techniques, such as the use of lime or cement dry soil mixing techniques would not be economically viable against the use of imported clean fill. Soil mixing techniques have previously been costed at some $150 to $200 per cubic metre for EPL.

Based on the above, land disposal of the dredged material is not likely to be feasible for this project.

7. References

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NOTES:

1. VERTICAL DATUM IS GISBORNE CHART DATUM WHICH IS 1.056m BELOW MSL (1926).
2. ALL LEVELS INCLUSIVE OF ALL TOLERANCES (EG: SURVEY AND DREDGING TOLERANCE). MATERIAL SHALL BE REMOVED NO DEEPER THAN INDICATED.
3. AREAS NOT SHOWN IN FILL MEANS NO CHANGE IN CAPITAL DREDGING DEPTH.

LEGEND

OUTER PORT NAVIGATION CHANNEL	DREDGING LEVEL -11.6m CD	(AREA = 118000 m2)
INNER PORT NAVIGATION CHANNEL	CAPITAL DREDGING DEPTH NOT CHANGING	
LOW SPEED SHIP MANOEUVRING AREA	DREDGING LEVEL -11.0m CD	(AREA = 25150 m2)
BERTH POCKET FOR WHARF 8	DREDGING LEVEL -10.9m CD	(AREA = 1300 m2)
BERTH POCKET FOR WHARF 7	DREDGING LEVEL -13.5m CD	(AREA = 9200 m2)
DEEP VESSEL TURNING BASIN	DREDGING LEVEL -10.6m CD	(AREA = 26300 m2)
SHALLOW VESSEL TURNING BASIN	DREDGING LEVEL -7.5m CD	(AREA = 4400 m2)
TUG MANOUVERING AREA	DREDGING LEVEL -8.1m CD	(AREA = 300m2)
TOP OF BATTER (INDICATIVE)		

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.21	ISSUED FOR INFORMATION	RP	-	CA	DA	CT			

A1 SHEET | SCALE

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

INFORMATION ONLY
NOT TO BE USED
FOR CONSTRUCTION

CUSTOMER: Eastland Port

Worley

EASTLAND PORT
PROPOSED CAPITAL DREDGING CONSENT
SITE PLAN

DRG No 301015-04045-MA-DSK-023 | REV A

WORLEY_A1_REV1

PLOT DATE & TIME: 14/2/2022 11:36:08 am
SAVE DATE & TIME: 14/2/2022 11:35:42 am
USER NAME: rachael.walthew
LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-023-025.DWG

NOTES:

1. VERTICAL DATUM IS GISBORNE CHART DATUM WHICH IS 1.056m BELOW MSL (1926).
2. ALL LEVELS INCLUSIVE OF ALL TOLERANCES (EG: SURVEY AND DREDGING TOLERANCE). MATERIAL SHALL BE REMOVED NO DEEPER THAN INDICATED.
3. BATTER SLOPES ARE 1V : 1.732H NORTH OF BUTLERS WALL UNO.
4. AREAS NOT SHOWN WITH NO FILL MEANS NO CHANGE IN CAPITAL DREDGING DEPTH.

LEGEND

OUTER PORT NAVIGATION CHANNEL	DREDGING LEVEL -11.6m CD	(AREA = 118000 m2)
INNER PORT NAVIGATION CHANNEL	CAPITAL DREDGING DEPTH NOT CHANGING	
LOW SPEED SHIP MANOEUVRING AREA	DREDGING LEVEL -11.0m CD	(AREA = 25150 m2)
BERTH POCKET FOR WHARF 8	DREDGING LEVEL -10.9m CD	(AREA = 1300 m2)
BERTH POCKET FOR WHARF 7	DREDGING LEVEL -13.5m CD	(AREA = 9200 m2)
DEEP VESSEL TURNING BASIN	DREDGING LEVEL -10.6m CD	(AREA = 26300 m2)
SHALLOW VESSEL TURNING BASIN	DREDGING LEVEL -7.5m CD	(AREA = 4400 m2)
TUG MANOUVERING AREA	DREDGING LEVEL -8.1m CD	(AREA = 300m2)
TOP OF BATTER (INDICATIVE)		

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT	

REF DRAWING No	REFERENCE DRAWING TITLE

A1 SHEET SCALE

OneWay
empowered | enabled | ethical

WORLEY PROJECT No.
301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

INFORMATION ONLY
NOT TO BE USED
FOR CONSTRUCTION

CUSTOMER

Eastland Port

Worley
energy | chemicals | resources

EASTLAND PORT
PROPOSED CAPITAL DREDGING CONSENT
OUTER HARBOUR
LAYOUT PLAN

DRG No
301015-04045-MA-DSK-025

REV
A

WORLEY_A1_REV1

LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-023-025.DWG

USER NAME: rachael.walthew

PLOT DATE & TIME: 14/2/2022 11:33:52 am

SAVE DATE & TIME: 14/2/2022 11:33:27 am

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET SCALE

OneWay™ empowered | enabled | ethical

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

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PRELIMINARY UNCHECKED

CUSTOMER

Eastland Port

Worley energy | chemicals | resources

EASTLAND PORT
FINAL MAINTENANCE DREDGING CONSENT
SITE PLAN

DRG No 301015-04045-MA-DSK-026

REV A

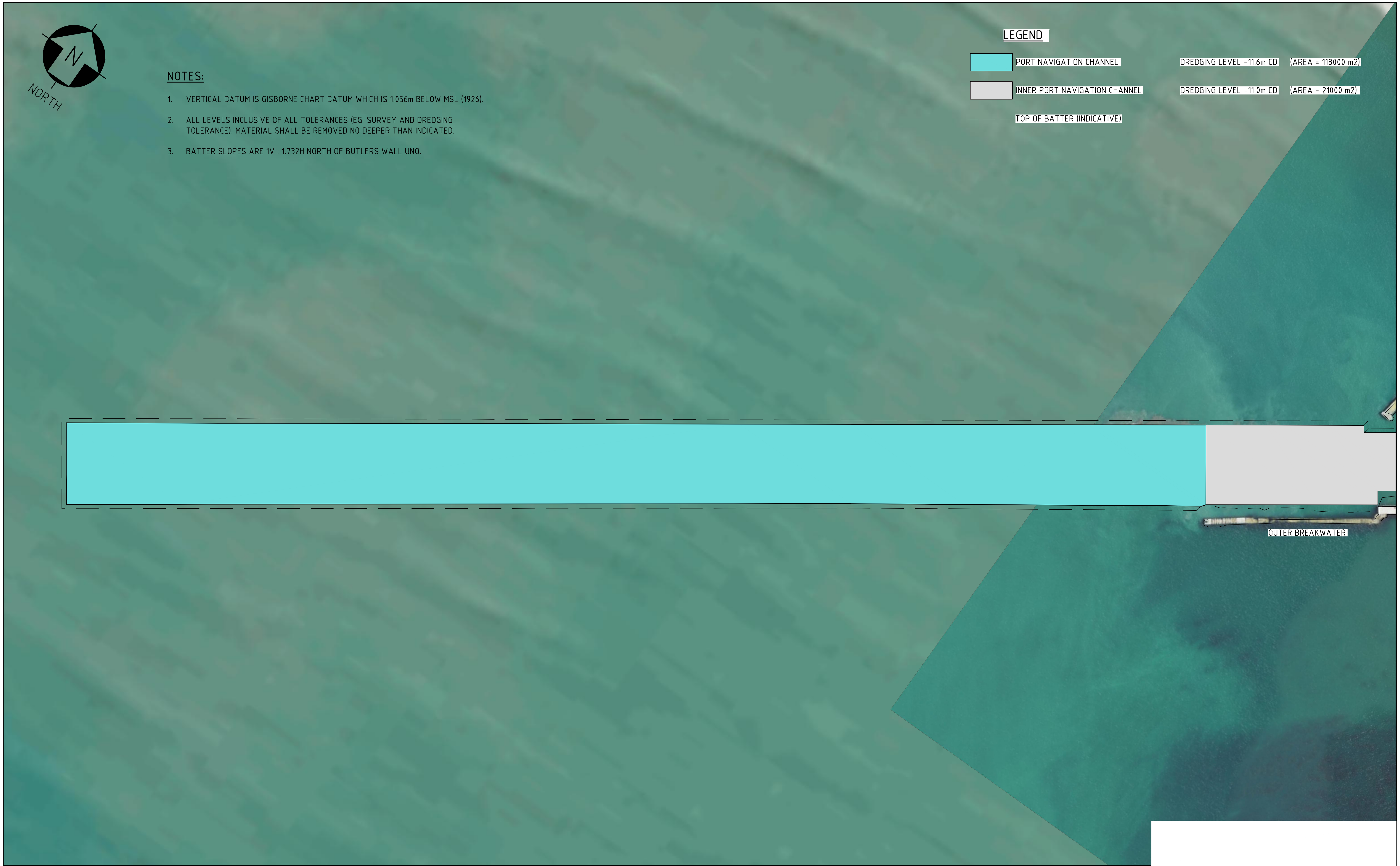
WORLEY_A1_REV1

LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-026-028.DWG

USER NAME: steven.hzami

PLOT DATE & TIME: 14/2/2022 11:56:58 am

SAVE DATE & TIME: 14/2/2022 11:52:27 am



NOTES:

1. VERTICAL DATUM IS GISBORNE CHART DATUM WHICH IS 1.056m BELOW MSL (1926).
2. ALL LEVELS INCLUSIVE OF ALL TOLERANCES (EG: SURVEY AND DREDGING TOLERANCE). MATERIAL SHALL BE REMOVED NO DEEPER THAN INDICATED.
3. BATTER SLOPES ARE 1V : 1.732H NORTH OF BUTLERS WALL UNO.

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET | SCALE

OneWay empowered | enabled | ethical

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

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PRELIMINARY
UNCHECKED

CUSTOMER
Eastland Port

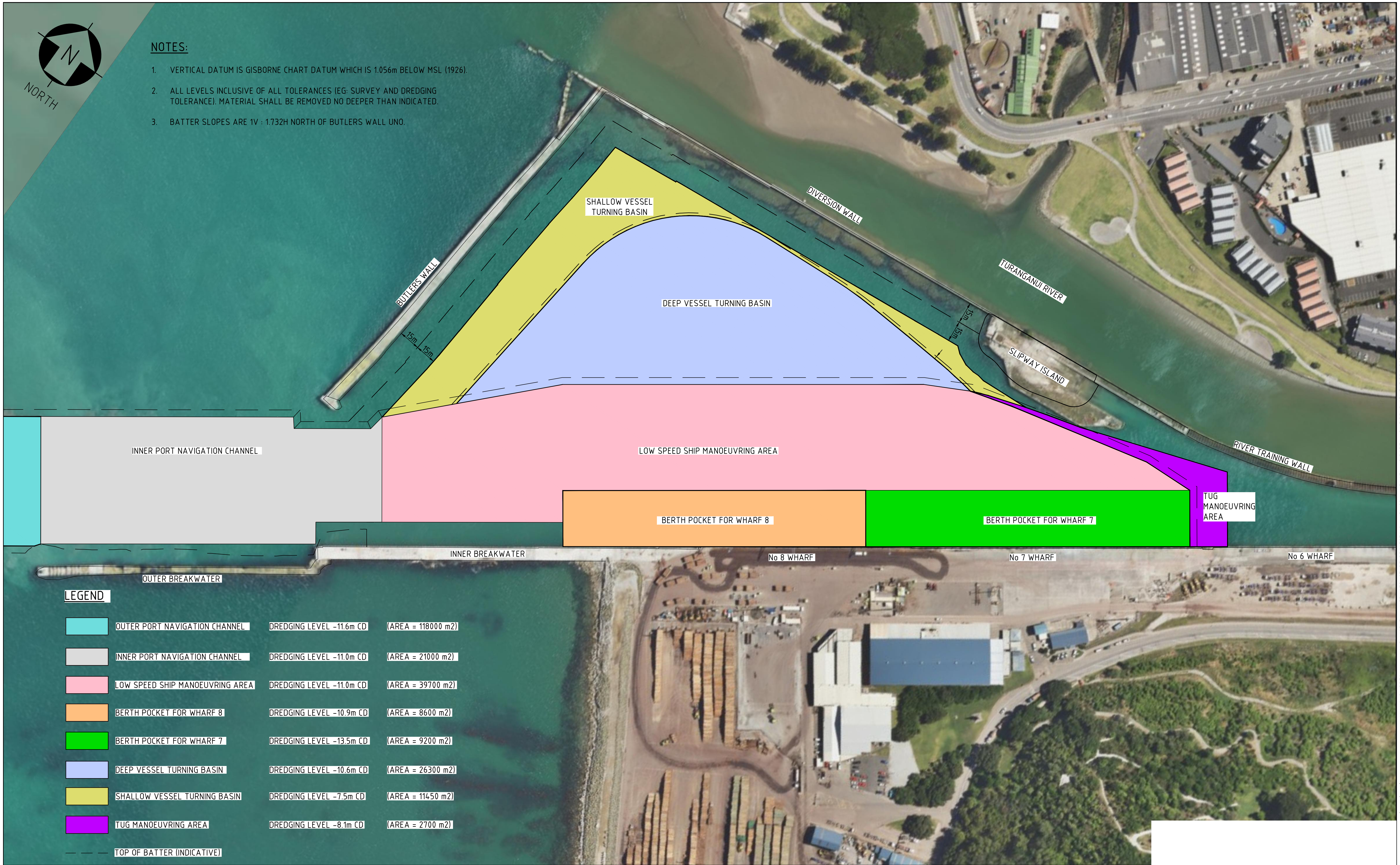
Worley energy | chemicals | resources

EASTLAND PORT
FINAL MAINTENANCE DREDGING CONSENT
NAVIGATION CHANNEL
LAYOUT PLAN

DRG No 301015-04045-MA-DSK-027 | REV A

WORLEY_A1_REV1

PLOT DATE & TIME: 8/2/2022 9:39:38 am
SAVE DATE & TIME: 4/2/2022 1:49:54 pm
USER NAME: steven.haami
LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-026-028.DWG



NOTES:

1. VERTICAL DATUM IS GISBORNE CHART DATUM WHICH IS 1.056m BELOW MSL (1926).
2. ALL LEVELS INCLUSIVE OF ALL TOLERANCES (EG: SURVEY AND DREDGING TOLERANCE). MATERIAL SHALL BE REMOVED NO DEEPER THAN INDICATED.
3. BATTER SLOPES ARE 1V : 1.732H NORTH OF BUTLERS WALL UNO.

LEGEND

OUTER PORT NAVIGATION CHANNEL	DREDGING LEVEL -11.6m CD	(AREA = 118000 m2)
INNER PORT NAVIGATION CHANNEL	DREDGING LEVEL -11.0m CD	(AREA = 21000 m2)
LOW SPEED SHIP MANOEUVRING AREA	DREDGING LEVEL -11.0m CD	(AREA = 39700 m2)
BERTH POCKET FOR WHARF 8	DREDGING LEVEL -10.9m CD	(AREA = 8600 m2)
BERTH POCKET FOR WHARF 7	DREDGING LEVEL -13.5m CD	(AREA = 9200 m2)
DEEP VESSEL TURNING BASIN	DREDGING LEVEL -10.6m CD	(AREA = 26300 m2)
SHALLOW VESSEL TURNING BASIN	DREDGING LEVEL -7.5m CD	(AREA = 11450 m2)
TUG MANOEUVRING AREA	DREDGING LEVEL -8.1m CD	(AREA = 2700 m2)
TOP OF BATTER (INDICATIVE)		

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET | SCALE

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

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PRELIMINARY
UNCHECKED

CUSTOMER

Eastland Port

EASTLAND PORT
FINAL MAINTENANCE DREDGING CONSENT
OUTER HARBOUR
LAYOUT PLAN

DRG No 301015-04045-MA-DSK-028

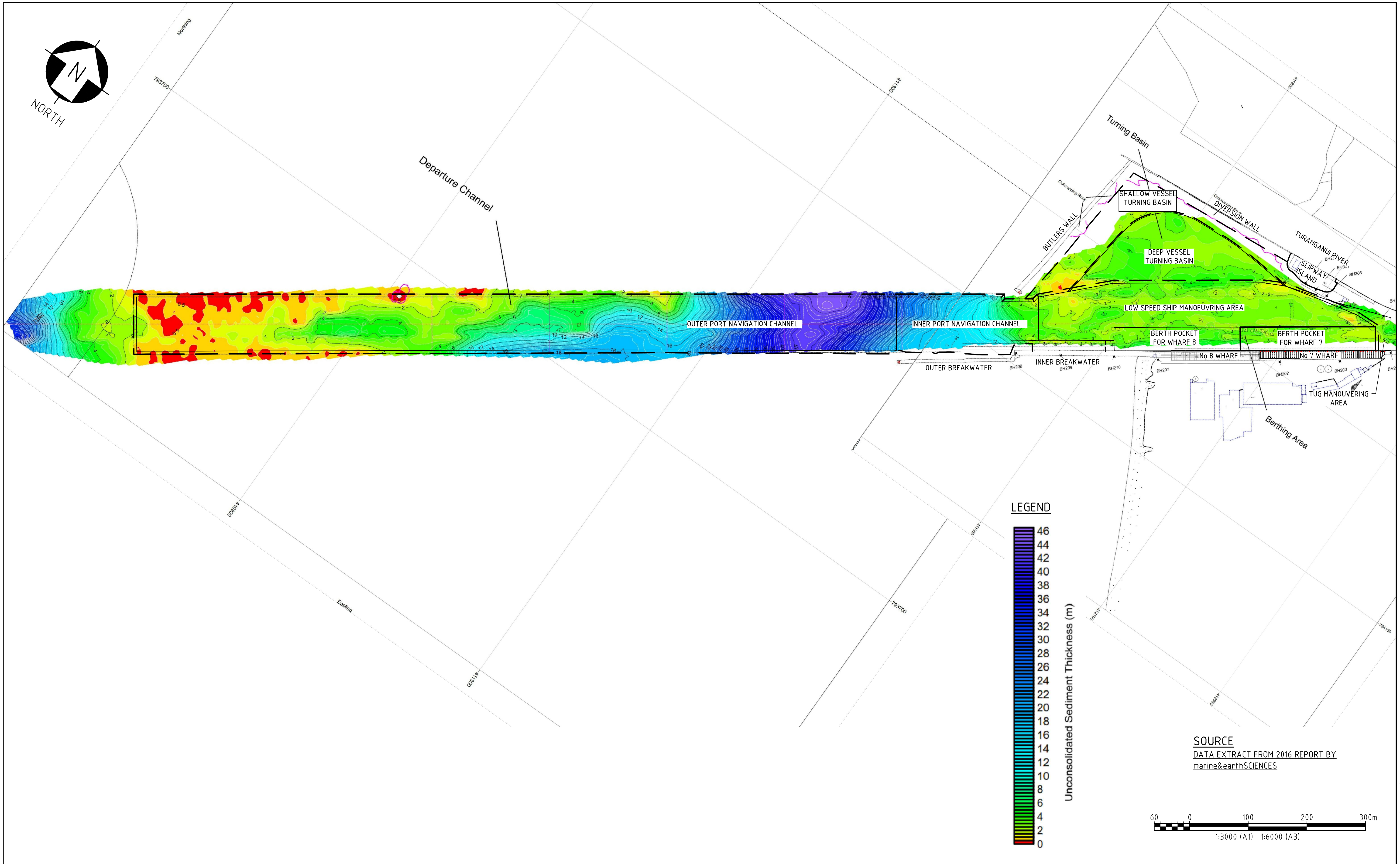
REV A

WORLEY_A1_REV1

LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-026-028.DWG

USER NAME: steven.haami

PLOT DATE & TIME: 14/2/2022 11:55:40 am
SAVE DATE & TIME: 14/2/2022 11:52:27 am



LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-036.DWG

USER NAME: steven.haami

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER
A	30.06.2021	ISSUED FOR IMFORMATION	RP	.	CA	DA	CT	

REF DRAWING No	REFERENCE DRAWING TITLE

A1 SHEET SCALE

OneWay empowered | enabled | ethical

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

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PRELIMINARY
UNCHECKED

CUSTOMER

Eastland Port

Worley energy | chemicals | resources

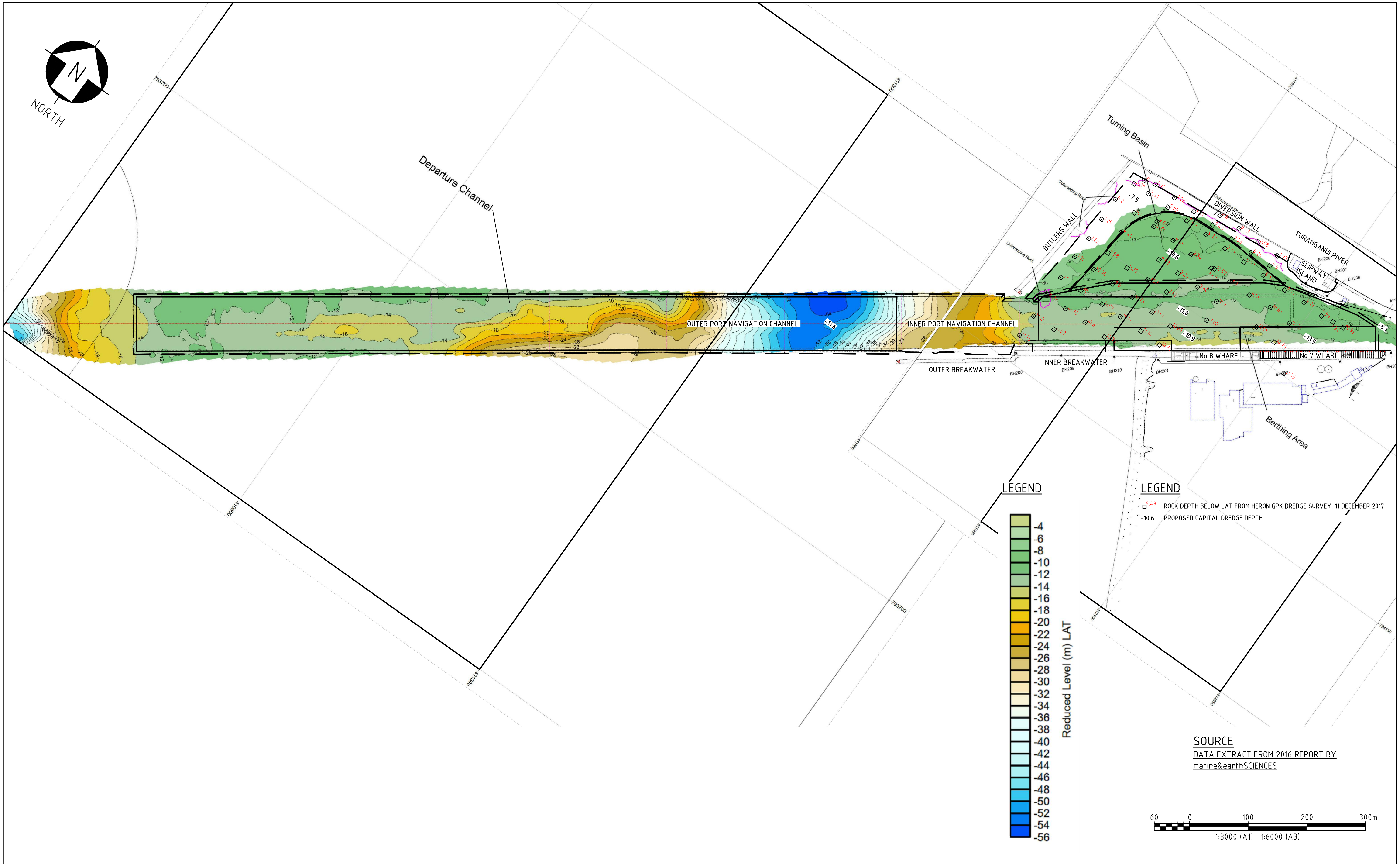
EASTLAND PORT
INTERPRETED THICKNESS OF
UNCONSOLIDATED SEDIMENT
LAYOUT PLAN

DRG No 301015-04045-MA-DSK-036

REV A

PLOT DATE & TIME: 8/2/2022 10:06:51 am
SAVE DATE & TIME: 4/2/2022 1:42:27 pm

WORLEY_A1_REV1



LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-037.DWG

USER NAME: steven.haami

PLOT DATE & TIME: 8/2/2022 10:11:03 am
SAVE DATE & TIME: 4/2/2022 1:41:20 pm

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	30.06.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET | SCALE

OneWay
empowered | enabled | ethical

WORLEY PROJECT No.
301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

INFORMATION ONLY
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PRELIMINARY
UNCHECKED

CUSTOMER

Eastland Port

Worley
energy | chemicals | resources

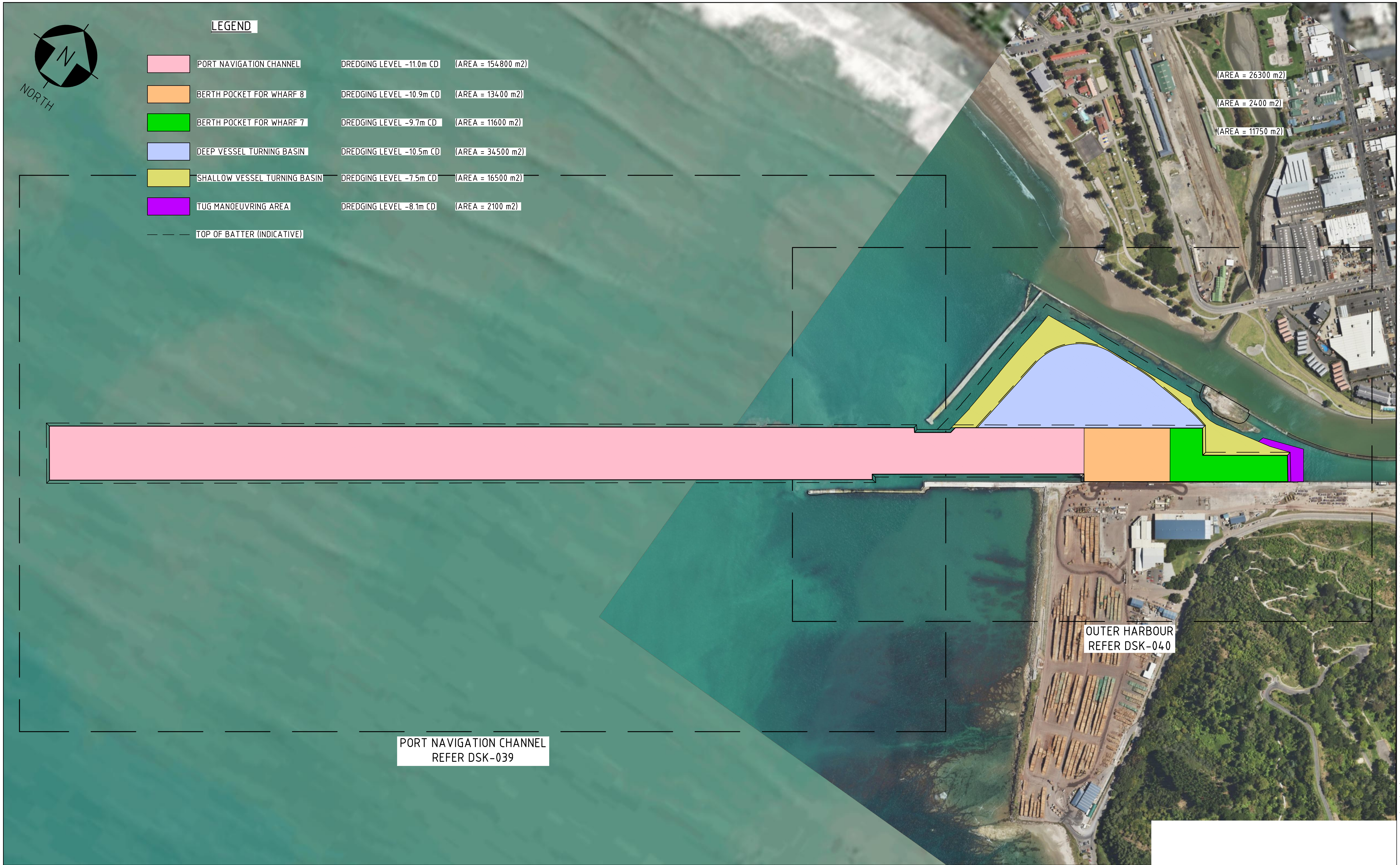
EASTLAND PORT

INTERPRETED ROCK LEVELS
LAYOUT PLAN

DRG No 301015-04045-MA-DSK-037

REV A

WORLEY_A1_REV1



REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET SCALE

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WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION

PRELIMINARY UNCHECKED

CUSTOMER

Eastland Port

Worley energy | chemicals | resources

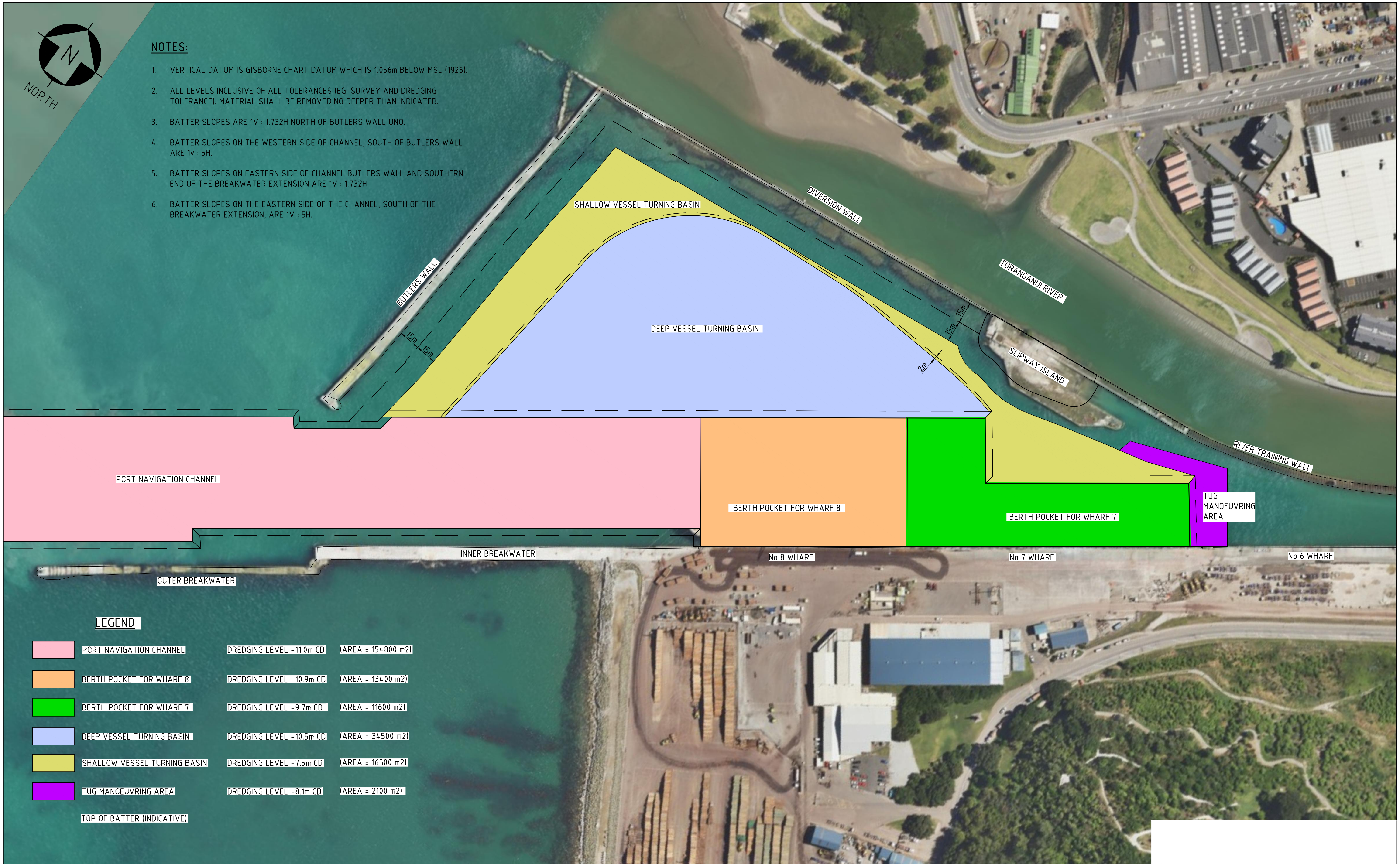
EASTLAND PORT
MAINTENANCE DREDGE LEVELS
SITE PLAN

DRG No 301015-04045-MA-DSK-038

REV A

WORLEY_A1_REV1

PLOT DATE & TIME: 9/2/2022 10:28:54 am
SAVE DATE & TIME: 8/2/2022 10:20:35 am
USER NAME: steven.hapimi
LOCATION: \\AUSYDWPDFS01V\AUSYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-038-040.DWG



NOTES:

1. VERTICAL DATUM IS GISBORNE CHART DATUM WHICH IS 1.056m BELOW MSL (1926).
2. ALL LEVELS INCLUSIVE OF ALL TOLERANCES (EG: SURVEY AND DREDGING TOLERANCE). MATERIAL SHALL BE REMOVED NO DEEPER THAN INDICATED.
3. BATTER SLOPES ARE 1V : 1.732H NORTH OF BUTLERS WALL UNO.
4. BATTER SLOPES ON THE WESTERN SIDE OF CHANNEL, SOUTH OF BUTLERS WALL ARE 1v : 5H.
5. BATTER SLOPES ON EASTERN SIDE OF CHANNEL BUTLERS WALL AND SOUTHERN END OF THE BREAKWATER EXTENSION ARE 1V : 1.732H.
6. BATTER SLOPES ON THE EASTERN SIDE OF THE CHANNEL, SOUTH OF THE BREAKWATER EXTENSION, ARE 1V : 5H.

LEGEND

PORT NAVIGATION CHANNEL	DREDGING LEVEL -11.0m CD	(AREA = 154800 m2)
BERTH POCKET FOR WHARF 8	DREDGING LEVEL -10.9m CD	(AREA = 13400 m2)
BERTH POCKET FOR WHARF 7	DREDGING LEVEL -9.7m CD	(AREA = 11600 m2)
DEEP VESSEL TURNING BASIN	DREDGING LEVEL -10.5m CD	(AREA = 34500 m2)
SHALLOW VESSEL TURNING BASIN	DREDGING LEVEL -7.5m CD	(AREA = 16500 m2)
TUG MANOEUVRING AREA	DREDGING LEVEL -8.1m CD	(AREA = 2100 m2)
TOP OF BATTER (INDICATIVE)		

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	9.09.2021	ISSUED FOR INFORMATION	RP	.	CA	DA	CT			

A1 SHEET | SCALE

OneWay empowered | enabled | ethical

WORLEY PROJECT No. 301015-04045

ENGINEERING AND PERMIT STAMPS (As Required)

INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION

PRELIMINARY UNCHECKED

CUSTOMER

Eastland Port

Worley energy | chemicals | resources

EASTLAND PORT
MAINTENANCE DREDGE LEVELS
OUTER HARBOUR
LAYOUT PLAN

DRG No 301015-04045-MA-DSK-040 | REV A

WORLEY_A1_REV1

LOCATION: \\AUSYDWPDFS01V\AU\SYD\WORLEY_INFRASTRUCTURE\PROJECTS\301015\03380 - EASTLAND PORT MARINE DEVELOPMENT PROJECT\12.0 DRAWINGS\SKETCHES\301015-04045-MA-DSK-038-040.DWG

USER NAME: steven.haami

PLOT DATE & TIME: 9/2/2022 10:28:22 am
SAVE DATE & TIME: 8/2/2022 10:20:35 am