EASTLAND PORT

Twin Berth Development
Design Parameter Justification

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EXECUTIVE SUMMARY

Eastland Port Ltd (EPL) in Gisborne, and the forestry industry in New Zealand's Tairāwhiti region, currently have a single berth (Wharf 8) from which ships are loaded with logs for export.

With its current assets, EPL's current log export capacity is approximately 3.0M JAS [1]per annum. Currently 3.0M JAS is exported, however Tairāwhiti's wood resource harvest is expected to peak at approximately 4.2M JAS before 2030. To meet the forecast export volumes, EPL must increase its capacity. This requires EPL to be able to load two Handymax sized vessels concurrently.

Alongside the wood resource trade, other products are anticipated to be exported from EPL in the future which require coastal shipping operators to berth and load. EPL has a desire to future proof its assets in anticipation of future export growth in wood resources, horticultural produce, wood processing, amongst other trades.

EPL also has numerous aging assets, some of which have reached the end of their design life compromising their structural integrity.

To achieve EPL's forecast export volume for all anticipated products and to address concerns with structural integrity of critical assets, a programme of works to upgrade and extend EPL's marine structures is planned. This programme of works is called the Twin Berth Development.

The key objectives of the Twin Berth Development therefore are to:

1. Increase the export capacity to cater to forecast export wood resource volumes,
2. Provide suitable business resilience to natural hazards,
3. Provide future opportunity for regional exports.

To meet these objectives, the following operating cases, design vessels and, required dredge depths were identified. These are set out in Table 1, Table 2. and Table 3

Table 1. Design Vessels

Vessel	Cargo	Length		Draft		Deadweight Tonnes	
		low	high	low	high	low	high
Handymax	Break bulk (logs)	150	200	11	12	35,000	50,000
Supramax	Break bulk (logs, wood chip/biofuel)	180	200	12	13	50,000	60,000
Moana Chief	Container ship		175	7	10		23,300
Reefer	Refrigerated vessel (kiwifruit, squash)	130	158	6	9	8,050	11,500

1 JAS = "Japanese Agricultural Standard" which is a measure of log volume that has become the default for the log export industry. 1 JAS = approx. 1m^3 = approx. 1tonne.

Table 2. Operating Cases

Twin Berth Development - Operating Cases
Fully load one 185 m Handymax ship and one 175 m container ship simultaneously
Fully load two 185m Handymax log ships simultaneously
Fully load one 185m Handymax ship and one 200 m Supramax ship simultaneously
Fully load one 185 m Handymax ship and one 158m reefer ship simultaneously
Fully load one 200 m Supramax ship and one 158m reefer ship simultaneously

Table 3 – Required Dredge Depths

Area	Consented Depth (incl. Tolerances) mCD	Current Maintained Depth mCD	Future Maintained Depth mCD	Constraint
Outer Channel	-11.6	-10.5	-11.0	Structural integrity of breakwater
Inner Channel	-11.1	-10.5	-10.5	Structural integrity of breakwater
Turning Basin (200m Ship)	-8.1	-7.5	-7.5	Lightship draught
Turning Basin (175m Ship)	-10.6	-7.5	-10	Lightship draught
Wharf 8	-10.9	-10.3	-10.3	Integrity of existing Wharf 8 structure
Wharf 7	-12.5	-8.6	-11.8	Design berth pocket depth for replacement Wharf 7 required for fully laden log ship.

Once the Twin Berth Development has been competed, EPL will:

1. Accommodate all the operating cases, and design vessels (except as noted below for the 200m Supramax vessel)
2. Meet the forecasted peak in wood resource export volume by concurrently loading two 185m Handymax ships.

It is noted however that the loading of a 200m Supramax ship may on occasion be draught limited due to the practical dredge depth that can be achieved in the shipping channel without compromising the integrity of the breakwater. To load such a ship to its design fully laden draught of 13.0m would require substantial investment in the breakwater which is deemed unnecessary to meet the objectives of the Twin Berth Development. This limitation would not apply to woodchip vessels due to that cargo having a lighter density.

TABLE OF CONTENTS

APPENDICES

1. ABBREVIATIONS

EPL	Eastland Port Limited
CD	Chart Datum
Design Dredge Level	Maximum dredge level that can occur. Operational Dredge Level + Construction and Survey tolerances
JAS	Japanese Agricultural Standard. Unit used to measure size of timber. This is approximately equal to 1 m^3 or 1 t of timber.
LAT	Lowest Astronomical Tide
Maintained Level	Minimum level in channels or pockets, including sedimentation that may occur. Operational Dredge Level – sedimentation allowance
mCD	Metres Chart Datum
NDT	Non-Destructive Testing
Operational Dredge Level	Minimum level dredge is to achieve in dredging campaign (excluding dredging tolerance and survey tolerance)
Port	Port of Gisborne
SUKC	Static Under Keel Clearance The required clearance under the keel of the ship. In determining this value, EPL include an allowance for squat and movement due to swell and infra-gravity waves.
TBC	To Be Confirmed
TLB	Twin Log Berth
WLY	Wharfside Logyard
UKC	Under Keel Clearance

2. INTRODUCTION

2.1 Background

To achieve EPL's forecast export volume for all anticipated products and to address concerns with structural integrity of critical assets, a programme of works to upgrade and extend EPL's marine structures is planned. This programme of works is called the Twin Berth Development.

2.2 Purpose of this document

This document is developed to:

1. Record the "current state" of the Port and the "end state" once the Twin Berth Development is completed,
2. Set out the projects scope and sequence for the Twin Berth Development,
3. Record high level design requirements for each project.

This document is intended to be a high-level summary to support discussions that the Port has with internal and external parties.

2.3 Facility Context

EPL is located in the city of Gisborne which is the commercial centre of the Tairāwhiti region in New Zealand.

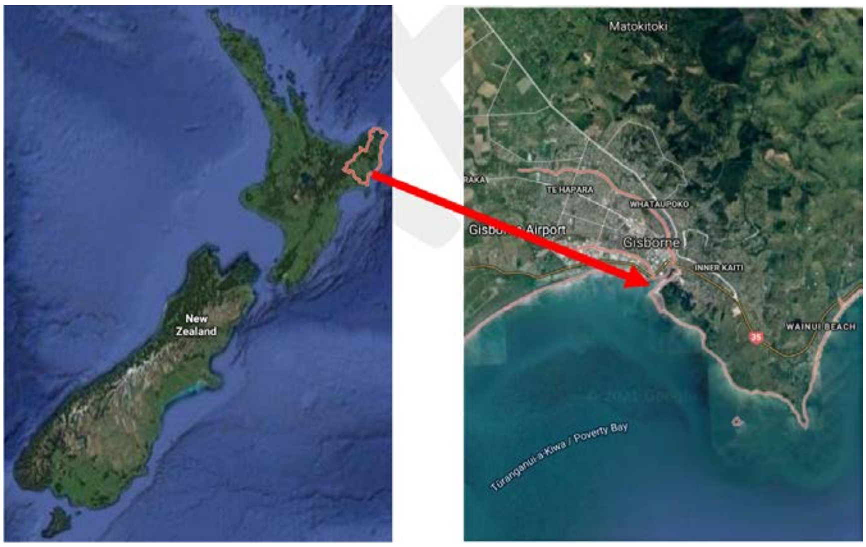


Figure 1. EPL Location Context

EPL is the only commercial port in the Tairāwhiti region and is therefore a crucial link between local productive industries (primarily forestry, horticulture and agriculture) and their export markets. It provides year-round export capacity and handles approximately 14% of New Zealand's export logs.

The current layout of the Port has been progressively developed from the mid 1800's from its prior origins as a river port. This has resulted in numerous structures that near to or past their design life and require substantial remediation to meet current needs. The figures below present a visual indication of how the Port has evolved.

Figure 2. Port of Gisborne circa 1870 as a river port (northerly perspective).

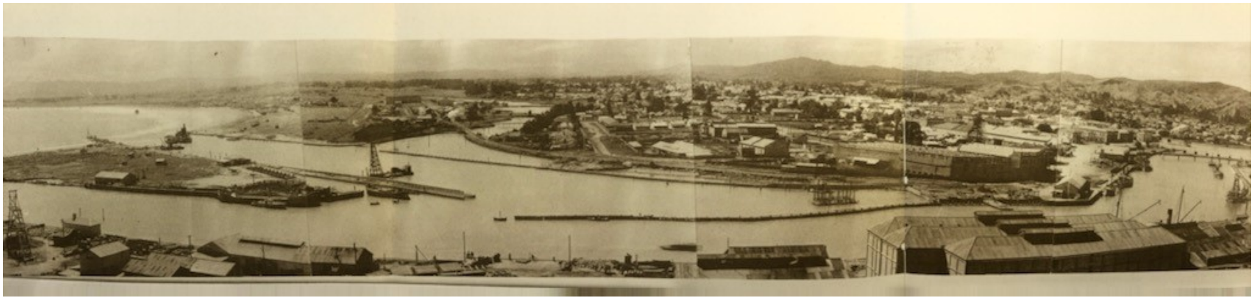


Figure 3. Port of Gisborne circa 1930, during construction of the river training wall and new river mouth to separate the port from the river (easterly perspective).

Figure 4. Present day configuration (southerly perspective showing wharf 7 and 8).

3. CURRENT STATE – FACILITY CONDITION

EPL is primarily a log export facility. While other seasonal export products include local produce (squash and kiwifruit) however these are of relatively small volumes.

The export capacity of EPL is approximately 3.0M JAS of logs per annum. The turnaround time for log ships is approximately 43 hours, with an average quantity loaded at EPL of approximately 23,110 JAS per ship. Approximately 130 log ships call to EPL per year.

To facilitate the accumulation of cargo prior to export, EPL currently has 12.4 hectares of onsite and 7.4 hectares of offsite log storage (Matawhero currently, Tolaga intended in the future), as well as cool and dry storage facilities at various locations.

3.1 Sizes of Visiting Export Ships

The following diagram sets out the typical range in length and draft of ships that service the Port.

Analysis indicates that the ships servicing the Port fall in to three main categories. These are:

- Refer ships which range between 130m and 150m with a draft of 6.0m to 9.2m
- Handymax log ships up to 185m with a draft of 9.5m to 10.7m.
- Supramax log ships 185 to 200m with a draft of 11.5m to 12.8m (although these are draft limited).

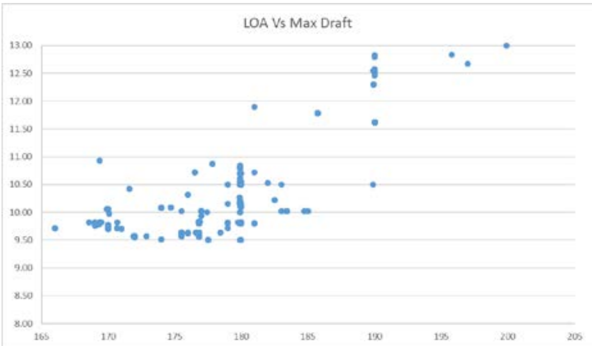


Figure 5. Sample data showing current LOA and draft of ships calling to EPL.

Given the current limitation's ships are draught limited (load limited) to approximately at 9.5m (Wharf 8) and 7.9m (Wharf 7), depending on various tidal and weather conditions, this means that almost all ships are not able to load to full capacity. This in turn will mean that there will be some ships that would come to EPL if there were less constraints choose not to come.

3.2 Assets

The current arrangement of EPL's structural assets are set out in the figure below.

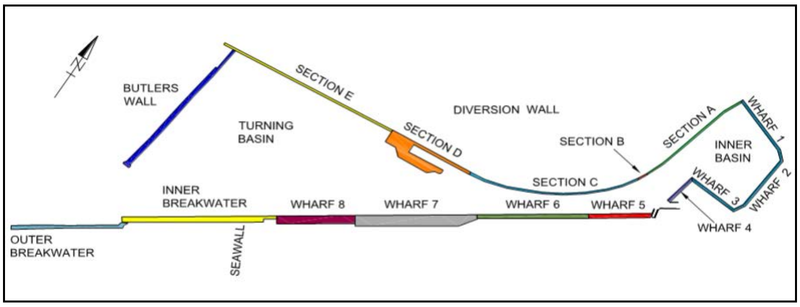


Figure 6. Current arrangement.

The function and high-level condition of each asset is set out below.

Table 4 – Asset Function and Condition

Asset	Function	Current Condition
Outer Breakwater	Protect other the port assets from waves	Poor, aging asset constructed on low quality ground in marine environment. • Situated on a deep layer of sediment • Settling at varying rates over its length • Anticipated in the years to come that if not reinstated it will sink to below water level
Inner Breakwater and Butlers Wall	Protect other the port assets from waves	Constructed from two stacked concrete block walls with fill between. • Situated on sediment of varying depths • Showing signs of age with cracks appearing • Outer half being repaired as part of routine maintenance • Inner half addressed as part of wharf 8 extension
Shipping channel and Turning basin (Swing basin)	Provide adequate depth and area for vessels to enter port and turn around.	Maintained
Wharf 8	Berthing of log ships	EPL's only current functioning wharf for log export. • Recent structural survey found it in reasonable condition for age with exception of occasional voids forming in underlying papa rock due to scour.
Wharf 7	Berthing current tug Waimata and reefer shipping	Wharf 7 has passed end of its design life and is now load limited. • Detailed structural assessment completed in 2017, concluded that the pretensioned concrete piles have suffered from chloride impingement to the extent where the pretensioned strands have been significantly compromised. • Investigations into options to return the structure to its original capacity found the associated cost would be significant • A study by Worley to assess the capacity of the Wharf 7 piles structure for the existing log ships, log trucks and proposed stevedore crane found that due to its existing condition, operational limitations would have needed to be implemented to the wharf
Slipway and diversion wall	Not used to support port operations	Slipway is in decay; remedial works required to maintain structural integrity. Constructed in current form in 1923: • External sheet piles have significantly corroded • Anchor rods have failed in many places • Wave action in storms eroding sections and snapping sheet piles Diversion wall maintenance as needed.
Wharf 6	Berthing of the Port dredge	Maintained as needed. Outside of the scope of the Twin Berth Development.
Wharves 1 – 5, and Inner Harbour area	Servicing of recreational and small commercial craft.	Maintained as needed. Outside of the scope of the Twin Berth Development.

3.3 Key Issues

The primary technical issues that are present and which constrain the current state either operationally or from further development, are:

- The Outer Breakwater (and outer portion of the inner breakwater) is founded on unconsolidated sediment and continues to settle. This limits the dredge depth of the shipping channel due to concerns about structural stability. The current dredge depth is limited to -10.4mCD.
- The Inner Breakwater design (concrete blocks layered from seabed) and its structural condition (cracks in capping layer) limit depth of the adjacent shipping channel to limited to -10.4mCD.
- Wharf 8 has a maintained dredge depth of -10.3mCD. Alongside this there are asset integrity concerns relating to:
    - Portions of a retaining wall at the eastern end of Wharf 8 starting to be undermined with scour.
    - Larger voids starting to form between piles due to scour of the cut face of underlying rock (note that the original design principle was predicated on piles spaced with approximate 600mm gaps and relying on that space being spanned by the underlying rock without significant failure.
- Wharf 7 has a maintained dredge depth of -8.6mCD. Alongside this an assessment of its prestressed concrete piles showing they are significantly compromised by chloride ingress to reinforcing.
- The Slipway is a redundant structure which extends into the harbour limiting vessel and tug movements. Alongside a condition survey shows portions of retaining walls within this structure that are failing, thereby allowing fill to spill into surrounding areas.

4. END STATE – FACILITY REQUIREMENT

The broad expectation of the end state (after completion of the Twin Berth Development) is to meet three criteria:

1. Provide seismic resilience such that emergency management can be supported after a major loss event,
2. Ability to meet the long-term peaks in forecast throughput log volumes (nominally 5M JAS at around 2028) and cater for growth in produce volumes,
3. Cater for larger more economical vessels.

4.1 Seismic Resilience

The Tairāwhiti region has a vulnerability to seismic events. Under the Civil Defence Emergency Management Act 2002, Schedule 1, Lifeline Utilities, the port of Gisborne is stated. This requires the Port to maintain a level of functionality to support emergency management situations.

Given the Wharf 7 is identified as needing to be replaced and opportunity presents to design the replacement structure to provide suitable resilience to provide for the emergency management situations. Such resilience has been determined to require an Importance Level 4 (IL4) as defined in the New Zealand Building Code.

4.2 Forecast Throughput

4.2.1 Log Supply

EPL has commissioned an independent survey of the future forecast log harvests from Tairāwhiti. The results of this analysis is set out below and concluded that log export volumes will continue to trend above current Port capacity and reach 4.0M JAS between 2046-2050. While not the only constraint, it highlights the Port is one of several constraints to the Tairāwhiti log export supply chain.

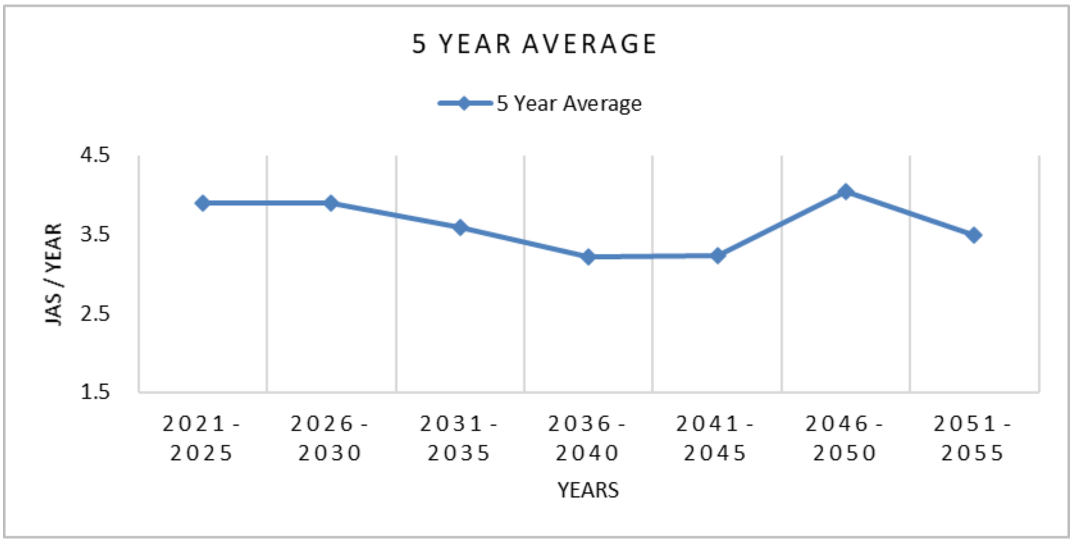


Figure 7 – Forecasted Log Volumes – Review of regional log availability –Forme Consulting

4.2.2 Port Capacity

By implementing the Twin Berth project the Port will not be a constraint to log exports from the region.

Table 5 – Forecast supply vs capacity

Year	Forecast log volume supply	EPL log export capacity	Infrastructure and operational changes
2020/21	3.2	3.0	
2021/22	3.4	3.0	MHC implemented
2022/23	4.1	3.0	
2023/24	4.0	3.3	Wharf 7 completed
2024/25	3.9	4.5	Wharf 8 extension completed
2025/26	4.1	4.5	
2026/27	4.1	4.5	
2027/28	4.2	4.5	
2028/29	3.2	4.5	

The following changes in capacity will result from those projects which make up the Twin berth project, directly being the Wharf 7 and 8 builds and the dredging programmes.

While it is anticipated that non-log shipping exports from the Tairāwhiti region will increase the design case for export volume, capacity for the foreseeable future will be the log trade. However, asset flexibility is required to ensure the ability to export other products is maintained.

In addition to logs, EPL also handles squash and kiwifruit in limited quantities. These need to continue to be accommodated as well as forecast growth in these volumes. Future trade is likely to also include containerized product for pickup by coastal shippers, and wood chips for export. Imports may include fertilizer.

4.3 Larger Vessels

Analysis of ships throughput during the April 17 – Oct 20 period shows each ship averaged 23,110 JAS, with loading rates allowing ships to turn around in 43 hours (pilot on board, to pilot off ship). There has been a progressive growth in the size of the log vessel consignments exported as ship capacity has increased by 25% over this period.

While this is a behavioural aspect it highlights the restrictions customers of EPL have. With a deeper dredged port, EPL will be able to welcome larger vessels and provide more economical outcomes for its customers by being able to load bigger vessels with larger consignments. This requirement is evident in figure 8 which illustrates this trend.

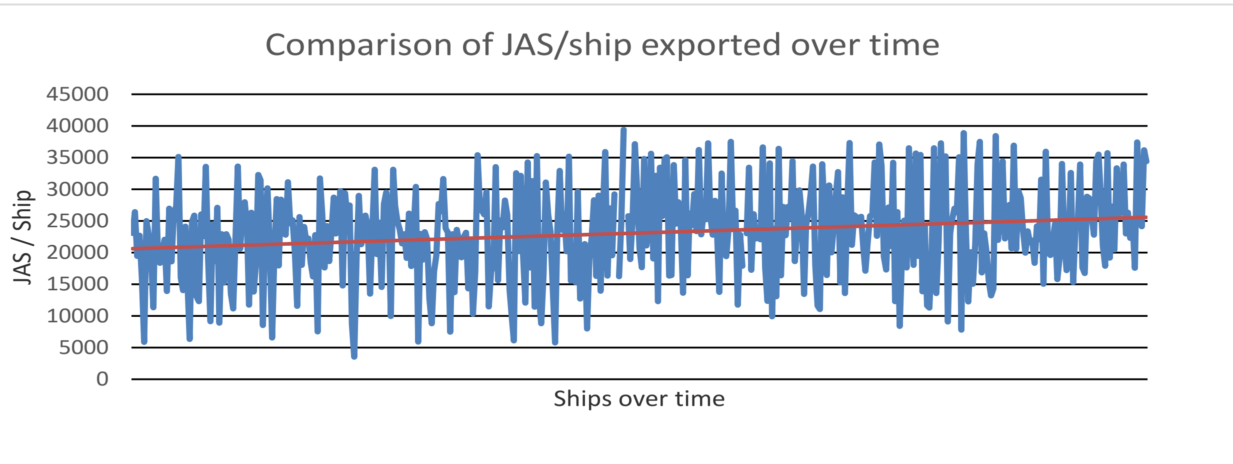


Figure 8 – Exports per ship over time

5. TWIN BERTH DEVELOPMENT

5.1 Objective

EPL has analysed its operation and assets to ensure it can meet the future demands of the region. This analysis has identified assets that need to be replaced or upgraded to allow the Port to meet the future export requirements of the region. These asset replacements or upgrades are collectively referred to as the Twin Berth Project.

The objectives of the Twin Berth Project are to:

1. Ensure the forecast capacity of Tairāwhiti's' log export market can be exported via Eastland Port.
2. Enable a more diverse mix of export products to be handled by Eastland Port allowing them to better serve the Tairāwhiti region.
3. Ensure the Tairāwhiti region has appropriate lifeline resilience.

5.2 Development Roadmap

The following sets out the roadmap taken to by Worley to define the Development for EPL.

Table 6 – Development Roadmap

Stage	Objective	Scope
1. Development Framing	To define the basic requirements of the development.	▪ Simulation of the entire supply chain to determine theoretical throughput capacity and bottlenecks under various scenarios. ▪ Identification and assessment of key risks and opportunities that will influence the outcome of the development.
2. Initial Site Assessments	To assess condition of existing assets and sit conditions.	▪ Geotechnical and geophysical investigations of the underlying ground conditions (including in the marine environment). ▪ Bathymetric surveys of the seabed and under water assets. ▪ Structural condition assessments of assets with known or suspected integrity issues. ▪ Long period wave analysis to inform design basis.
3. Planning	To determine likely cost of the overall development and high-level plan to deliver the development.	▪ Optioneering for the required upgrades of development of each asset ▪ Cost estimating and selection of options ▪ Development of the Overall port layout and design basis ▪ Documentation of a procurement strategy after assessment of market conditions and indicative plan to deliver each project, including project sequencing.
4. Delivery of Projects	To deliver each discrete project as required.	▪ Completion of basic engineering packages to support resource consents. ▪ Completion of detailed engineering packages to support procurement of construction works. ▪ Procurement and construction of works.

5.3 Theoretical Capacity

Supply chain assessments showed that the required 4.3M JAS/annum peak log throughput is theoretically possible with the current configuration (i.e. just using Wharf 8) as long as the optimised ship turnaround duration was maintained at two days and as long as no weather delays occurred (e.g. 365 days per year operating). However historical records show weather and other delays created 30% downtime, reducing the useable days to 256 days per year.

An assessment has been undertaken based on historical data of exported log volumes, ship turnaround time, operations input and weather related down time, to provide an indicative more realistic capacity. When considering these more real-world scenarios that account for theses constraints it is reasonable has been assessed the maximum capacity the current port configuration is effectively 128 ships per year which equates to 3.0m JAS/year (256/2 days = 128 ships per year, 23,110 JAS / ship) which is less than the required throughput and will make the port the export constraint. Hence the justification for needing the ability to load from two log berths. It should be noted that discussions with the port have indicated that additional capacity as a result of a deeper berth on completion of wharf 7 should see a slight increase of approximately 0.3 JAS/year as a result of being able to load deeper draught ships.

Table 7 – Log Export Capacity

Scenario	1 x 185	2 x 185
Max Ships	128	192*
JAS Capacity	3.0 – 3.4**	4.3 – 4.5M***

* When operating 2 berths a ratio of 1 full time occupancy and 1 x 50% occupancy has been used
** 3.3M JAS/year on a single berth relates to the ports assessment of realistic capacity once Wharf 7 is complete due to deeper draught ships.

***Port capacity is more than the forecasted maximum log volume of 4.3M JAS/year (5.0M JAS/year = 16% more).

The other current key regional export the port facilitates is produce exports such as kiwifruit and squash which are exported on approximately 10 ships per year from the current Wharf 7. With the continued condition of Wharf 7 this is likely to be compromised in the coming years which would move the ships to Wharf 8 further limiting the export capacity of the port should Twin Berth not proceed. However, with the Twin Berth project and the capacity it will provide this will ensure that this regionally significant export can continue.

5.4 Key Optioneering Analyses

Given certainty in the requirement for a second log export berth and identified issues with each asset, the significant optioneering work focused on:

1. Whether to repair or replace Wharves 6 and 7; a replacement option was selected when it was shown that chlorides (from sea water) had deeply penetrated the wharf piles and put the pre-tensioned reinforcing within the piles at significant risk of failure due to corrosion.
2. What actual reclamation area/layout was required for log storage and ship access; a minimal layout area adjacent to the future Wharf 8 extension was selected when it was shown that on port log storage volumes was not a bottleneck to the supply chain meeting the peak log throughput, however, additional reclamation area is required to ensure mobile plant access to the future position of Wharf 8.

In additional to physical asset options, ship sizes also need to be assessed. Designing the port to accommodate the appropriately sized ship is key in ensuring a fit for purpose design. As a result, various combinations of ship lengths have been considered for this assessment:

1. One 185 m log ship and one 175 m container ship at the same time,
2. Two 185 m log ships simultaneously,
3. One 185 m log ship with one 200 m log ship at the same time,

4. One 185 m log ship and one 200m woodchip ship at the same time,
5. Two 200m log/woodchip ships.

These ship lengths have been considered as they are the ship combinations that are likely if all the possible future opportunities were realised.

5.5 Specific Projects

The discrete projects to be delivered are set out below. These are arranged two groups being:

- Group 1; those that are required to address immediate structural integrity concerns, or those that have simple engineering and consenting requirements to enable construction:
  - Adjustment of Wharf 1 and the Inner Basin for Tug Berthing
  - Rebuild of Wharf 7 and the southern end of Wharf 6 to address significant structural integrity issues.
  - Reshaping of the Slipway to improve tug and ship manoeuvring.
  - Proof of concept to strengthening the Inner Breakwater.
- Group 2; remaining projects that have complex engineering and consenting to enable construction.
  - Extension of Wharf 8 to accommodate longer ships.
  - Extension of the southern Reclamation to provide adequate access for mobile plant to the new Wharf 8 position.
  - Reinstatement of the Outer Breakwater.
  - Capital and maintenance dredging.

5.6 Required Operational Changes

Alongside projects to make physical changes to assets, there were numerous operational changes required to enable a Twin Berth facility to operate. These changes are:

- Wharf 7 would transition to being primarily a log export berth, with the ability to change to woodchip/biomass export if required.
- Wharf 8 will remain a primary log export berth (albeit draft limited), with the ability to change to bulk produce and container exports as required.
- Ongoing efforts to optimise on port log storage and ship loading rates.
- Freeing up redundant space by relocating non-essential assets elsewhere to operational port land.
- Freeing up berthing capacity by moving the tug berthing location.

6. DESIGN SHIPS

As found in Section 7.10 a fully loaded 200m ship would require the inner channel to be significantly dredged, which would in turn cause the Inner and outer breakwater to be upgraded as well as the end of Butlers Wall to re assessed for stability. EPL agreed that this step could therefore be considered as a disproportionate step as 2 x 185m log ships fully loaded can deliver the required capacity.

As all the rest are feasible it is proposed that the wharf length should be such that 1 x 185m and 1 x 200m ship can be berthed at the same time. This combination will allow all the other cases to be met.

Notes:

1. It is not expected that there would be the market to have two woodchip ships load at a time. Therefore, designing for two woodchip ships is not required.
2. 185m would allow the container ship Moana Chief to be accommodated at the port (LOA 175 m)

6.1 Berthing Two Ships

Due to the restricted size of the turning basin, ships are unable to turn while a ship is moored at Wharf 8 (refer to the location of the stern to the turning ship in Figure 21). Due to this, there is a requirement to berth two ships at the same time, the first ship will need to move to Wharf 7, to allow the second ship to berth at Wharf 8.

Due to this it proposed to design each wharf for the following ship lengths:

- Wharf 7 - 200 m ship
- Wharf 8 - 185 m ship

6.2 Twin Berth Design Ships

There are several future opportunities that the port is considering which require different ships berth. These are summarised as follows:

- Log Shipping falls into 2 distinct groups of ship length:
  - Handymax less than 185m LOA
  - Supramax greater than 185m and less than 200m LOA
- Coastal Container Shipping
  - This would be serviced by a ship similar to the Moana Chief at 175m LOA
- Woodchips/biofuel
  - This would be serviced by a Supramax ship of 200m LOA

6.3 Log Ships - Historical Information

When considering log shipping there is good historical data when considering the size of ships based on information about the ships that have visited the port in the past.

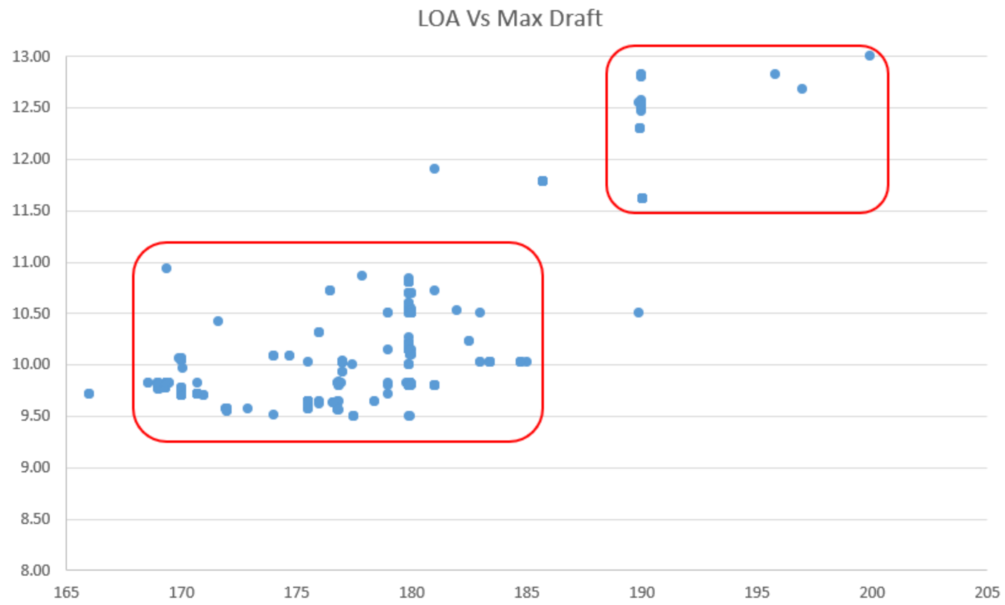


Figure 9 – Ships that have visited Eastland Port based on Length and Max Draught

By drawing a graph of the ships that have visited the port comparing "Length Over All" and "Maximum Draught" (Figure 9) it can be seen that these fit into two main categories.

- Ships less than 185m and a draughts of 10.7m or less. These ships make up 92% of all the log ships that visit the port (804 ships out of 870).
- Ships more than 185m but less than 200m. These ships make up 8% of all the log ships that visit the port (66 ships out of 870).

6.4 Log Ships – Future Design Basis

As seen above for log shipping opportunities there are two main vessel sizes for Eastland port (<185m and >185m). However, as the design of the port will need to be valid for 50 years we also need to consider if the size of sips has any trends that may affect the port in the long term. To assess this the build date of the ships that had visited the port against maximum draught was considered (see Figure 10)

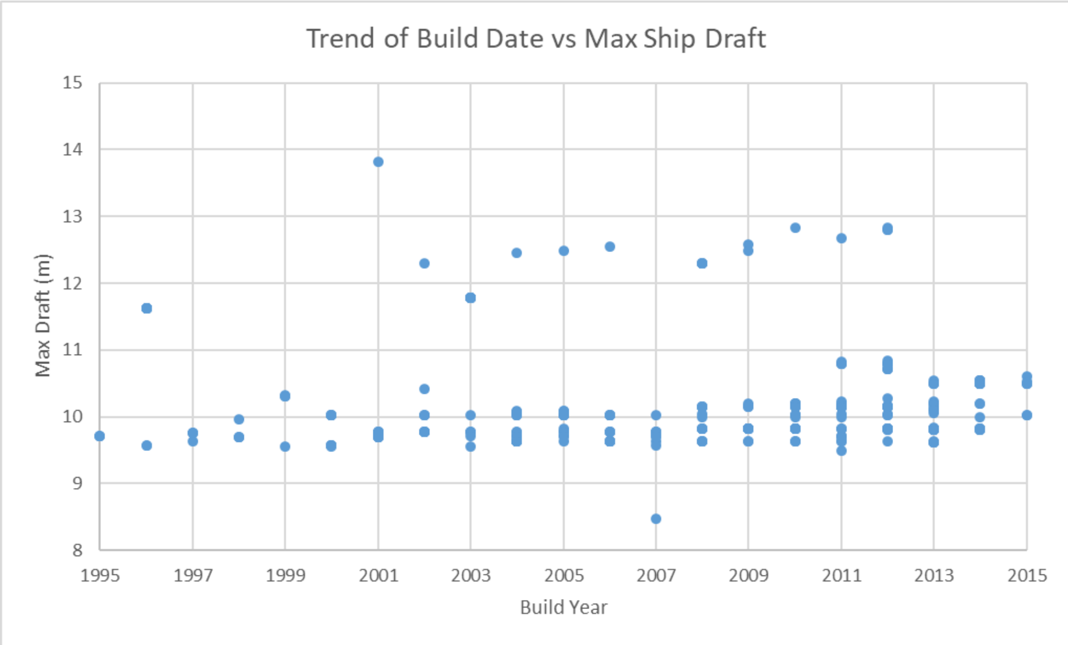


Figure 10 – Graph of Build date against Max Draught for ships that have visited Eastland Port (4/2016-3/2017) (WorleyParsons, 2017).

From the above it can be seen that the draughts of the newer ships is increasing slightly, however, this trend in only increasing slightly so should not impact the port significantly.

Therefore, for the purposes of this report based on the above and section 6.3 the Design log ships will be

Table 8 – Design Log Ship Parameters

	Handymax Log Ship	**Supramax Log Ship**
LOA	185m	200m
Draught	10.7m	12.8m

Notes:

1. Ships are currently draught limited due to the level of the shipping channel and Wharf 8 berth pocket.

6.5 Coastal Container Shipping

Depending on container volumes in and out of Eastland, there is the potential for coastal shipping to be an economical alternative to road transport. This service is anticipated to operate using ships similar to the MV Moana Chief. Therefore, for the purposes of this report the MV Moana Chief will be use as the design ship for coastal container traffic.

Table 9 - MV Moana Chief Principle Particulars

Name	MV Moana Chief Formally: HANSA LUDWIGSBURG (IMO: 9516741)
Gross tonnage	18,358
Deadweight	23,305
Build	2011 by WENCHONG SHIPYARD
LOA	175mT
Beam	27.67

Max Draught	10.9m
Capacity	1,740 TEU

6.6 Wood Chip (Biofuel) Ships

Another future opportunity being considered by Eastland Port is Woodchip trade. This service would require a ship similar to the MV Kutai Express. Therefore, for the purposes of this report the MV Kutai Express will be use as the design ship for the Woodchip export design ship.

Table 10 – MV Kutai Express Principles Particulars

Name	MV Kutai Express (IMO: 9298923)
Gross Tonnage	40,275
Deadweight	49,794
Build	2008 by IWAGI SHIPBUILDING
LOA	199.91 m
Beam	32.2 m
Capacity	105,000m^3 ▪ Calculated as 42,000mT of woodchips @ 400kg/m^3
Max Draught	42,000 tonnes woodchips = 10.3 m ▪ Round to 10.5m to allow for fuel etc

6.7 Summary of Key Information

In summary it can be seen that in order to assess the requirements that the port needs to be designed against for this suit of projects. Given the future opportunities being considered the key requirements for consideration are as shown below in Table 11. It should be noted that these are not necessarily the ships that will be accommodated but are the ships that the various requirements need to be measured against.

Table 11 – Summary Table of Ship's Principle particulars2

Ship Type	Handymax (Current Draught)	Handymax (Fully loaded)	Supramax (Fully Loaded)	Supramax (Draught Limited)	Container Ship	Supramax (Woodchip)
Ship Name	N/A	N/A	N/A	N/A	MV Moana Chief	Kutai Express
LOA	180 m	180 m – 185 m	200 m	200 m	175 m	200 m
Arrival Draught*	7.9 m	7.9 m	TBC	TBC	10.9 m	7.5 m
Departure Draught	9.8 - 10.2 m	10.2 – 10.7 m	12.8 m	10.0 m	10.9 m	10.5 m (Estimated)

* It should be noted that bow and stern draughts are normally different when ballasted. However, for this report they are considered to be the same. This gives a slightly conservative design parameter that can be further optimised in the design for items such as the Turning basin.

[2] Refer to Appendix 1 for Vessel drawings

6.7.1 Design limitations

There are two limitations that mean it is impractical to meet all of the requirements for all design ships; these are:

1. The maximum draught required by a fully laden 200m log ship; this would necessitate massive investment upgrade the Breakwater. While a 200m log ship is anticipated at EPL in the future it is not necessary to fully load this to achieve the forecast log throughput. With these points in mind a pragmatic approach has been taken to not strive for the required fully laden draught.
2. The maximum draught required of the Moana Chief is 10.9m; however, needing to accommodate a fully laden Moana Chief is considered very unlikely given the nature of coastal shipping in New Zealand. Evidence gathered from other ports in New Zealand show historical arrival and departure draughts of the Moana Chief ranges as follows (these figures will be taken as a pragmatic basis to enable the Moana Chief to visit).
   - Arrival - from 7.4m to 9.7m
   - Departure - 7.6m to 10.0m

7. DESIGN PRINCIPLES

Given the above information there are upgrades required to specific structures at EPL. These are set out below per structure.

7.1 Wharf 7

The proposal to replace Wharf 7 rather than repair is guided by

- Wharf 7 being past its design life and requiring significant maintenance to achieve its original capacity. Inspections were undertaken in 2017 (Advisian, 2017) which concluded that the pretensioned concrete piles have suffered from chloride impingement to the extent where the pretensioned strands have been significantly compromised. The investigations on Wharf 7 that fed into this report included various NDT, structural inspections and detailed analysis of the structure.
- Investigations into options to return the structure to its original capacity found the associated cost would be significant (WorleyParsons, 2018)
- A study by Worley to assess the capacity of the Wharf 7 piles structure for the existing log ships, log trucks and proposed stevedore crane found that due to its existing condition, operational limitations would have needed to be implemented to the wharf (Worley, 2019)
- The retaining wall behind Wharf 7 is being undermined by up to 1m in places as found in the Wharf 7 condition assessment in 2017 (Advisian, 2017). This undermining is a result of the bedrock weathering over time and is anticipated to continue until the bedrock reaches a stable slope.
- The design dredge level for Wharf 7 is 32' (-9.8 mCD). Based on the SUKC in the berth pocket (0.7 m) and a sedimentation allowance (0.4 m) this would indicate that the max ship draught for the wharf is 8.7 m. The log ships visiting tend to have a max draught between 9.8 m and 10.8 m. This means the berth is not capable of handling the current log ship traffic, without deepening, which is unachievable on the existing structure.

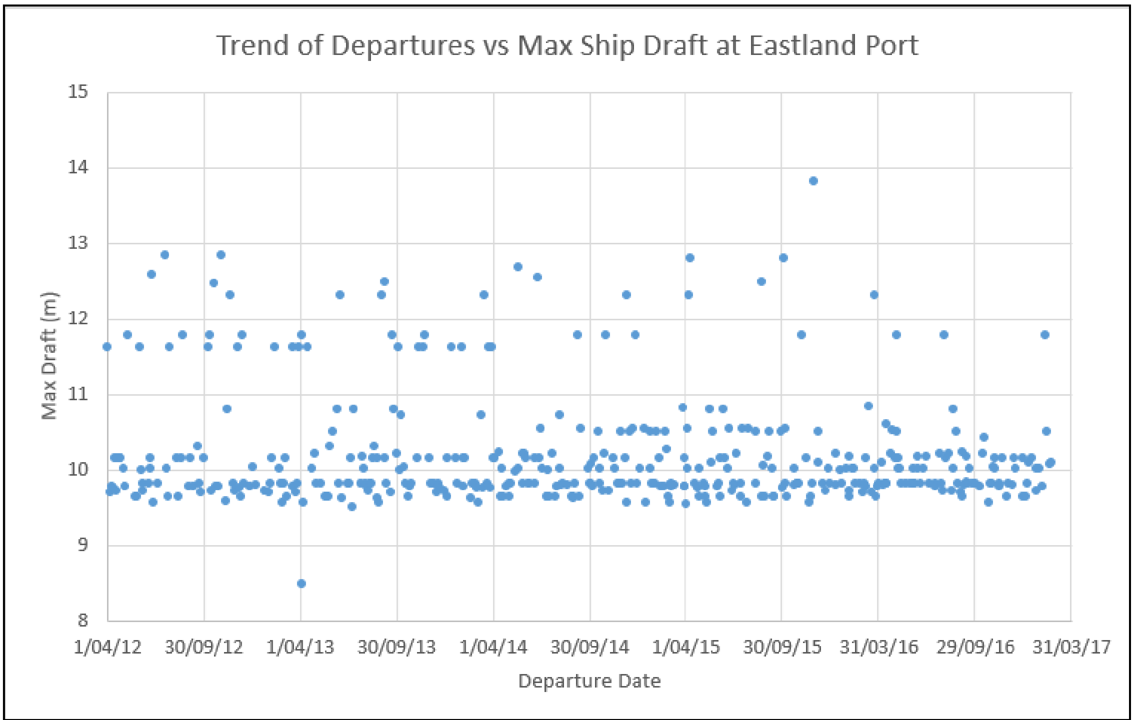


Figure 11 – Historic graph of departure date against ship draught.

As part of this decision process, EPL engaged WorleyParsons to investigate options for both maintaining the wharf and creating a new wharf (WorleyParsons, 2018). This report detailed repair costs associated with Wharf 7 ranging from NZ$22M NZ$26M with the full replacement costing NZ$31M – NZ$38M. As a result, EPL have taken the view that it is better to invest NZ$10 NZ$15M beyond the just repairing cost to create a purpose-built structure that will have a lower ongoing maintenance cost and allow the port to meet future opportunities.

7.2 Wharf 8

EPL are also including as part of the overall twin berth development the impact on Wharf 8 and requirements for its' upgrading. This impact would primarily be to extend Wharf 8 at the current maintained dredge level of -10.3mCD (when using a 600mm dredging tolerance) to accommodate additional overall wharf face length.

Wharf 8 was built in 1997 as a primarily bored concrete pile quay wall structure restrained horizontally at the top by rock anchors, filled behind the wall, with a concrete pavement surface on top.

Extending Wharf 8 to accommodate the ships requires the following aspects:

- A reclamation at the southern end (breakwater end) of the wharf to allow truck swing circles for loading ships,
- Strengthening of the breakwater in the section to be reclaimed.

However, this work will be limited to a design that is equivalent to the current Wharf 8 structure rather than future proofed for additional dredging. This decision is based on the understanding that in order to realise the advantages any future proofing extensive modifications to the current Wharf 8 would be required.

7.3 Breakwater

The Breakwater at EPL is divided into two sections.

- The Inner Breakwater section which is made of very large orthotopes (3D rectangle) stacked on top of each other to create two outer walls, which was infilled between the walls with a fill of rocks and other materials. A mass concrete cap has been poured over the top of the walls and fill.
- The Outer Breakwater section constructed in three methods along its length, consisting of:
    - Large orthotopes stacked on top of each other, in a truncated pyramid shape,
    - Large concrete caisson assumed to be backfilled with rubble or concrete,
    - 20 foot (6.1 m) long 20-ton concrete blocks, manufactured to key together as they are stacked on top of each other. These are placed on top of rubble material held in place at the sides by 10-ton concrete cubes.

A mass concrete cap has been poured over the top of all these sections.

The first half of the Inner Breakwater is understood to be founded on "papa" clay/mudstone. South of this section, the breakwater is sited on unconsolidated sediments that are believed to be over 20 m deep. Both the Inner and Outer Breakwater are starting to need repairs in different ways.

- The Inner Breakwater:
    - Requires additional work to prevent cracks that are visible in the concrete capping from propagating and worsening, potentially causing the breakwater to collapse into the shipping channel

Figure 12 – Inner Breakwater inspection 27 July 2019 (photo by C Thomas)

Figure 13 – Inner Breakwater inspection 27 July 2019 (photo by C Thomas)

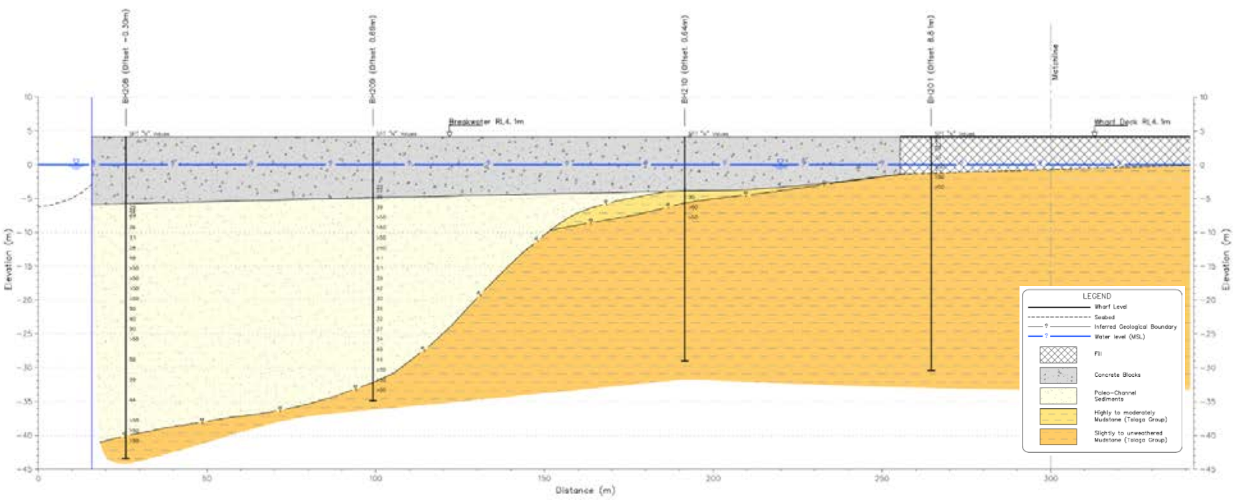


Figure 14. Long section of the inner breakwater showing depth of unconsolidated mudstone underlying the structure (Tonkin + Taylor)

- May need work to prevent the caves identified in the dive survey from 1966 worsening and causing issues with the visible cracks (Gisborne City Council, 1982).
- This work is anticipated to cost $30.2M

- The Outer Breakwater needs work to maintain its level above sea level. This is driven by:
  - Should the maintenance be undertaken when the Outer Breakwater has settled to a point where it is below the sea level, it will cost disproportionately more to maintain when it is required,
  - It is not economically feasible to prevent the Outer Breakwater from continuing to settle,
  - An estimate from 2017 (WorleyParsons, 2017) to reinstate the Outer Breakwater put the repair at approximately NZ$34.30M

With the above considered, EPL believe that it is worth the investment now to remediate the issues relating to these topics rather than face the significant and extended cost to the business and community should the breakwater become significantly unstable or fail into the shipping channel.

7.4 Port Navigation Channel

The port navigation channel is the only access to the port for ships. For the basis of this report, it is broken into two sections Inner Channel and outer Channel. These sections are indicatively shown (in Figure 15) below.

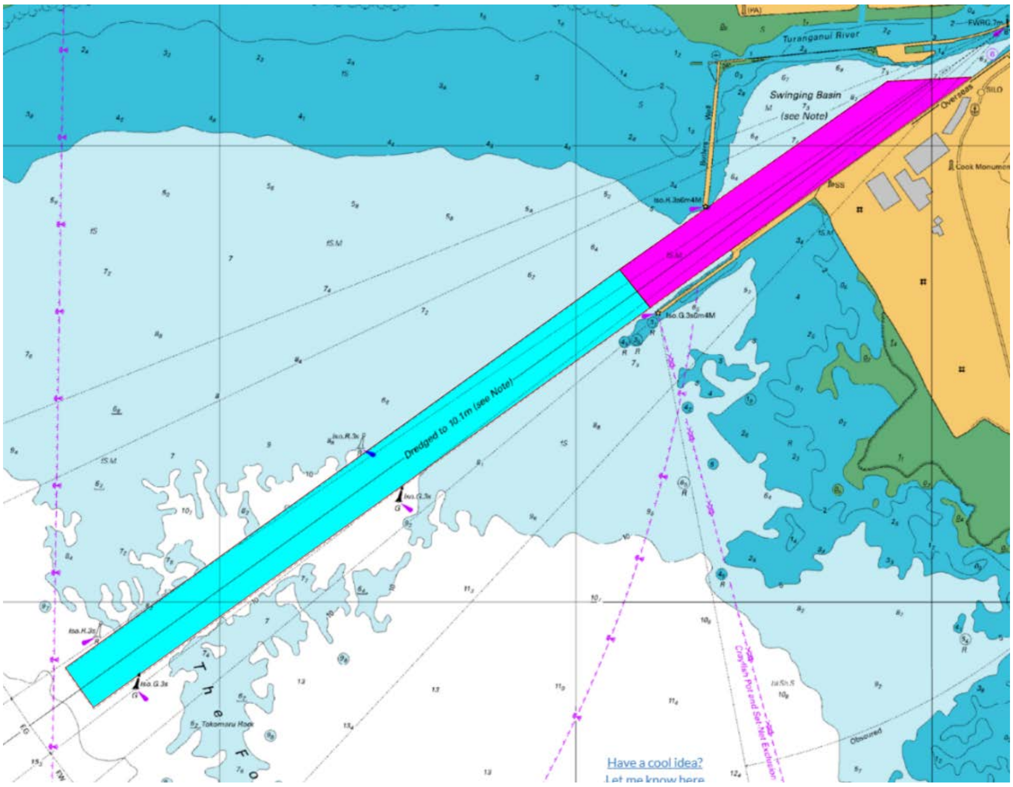


Figure 15 – Port Navigation Channel Sections

7.4.1 Outer Channel

The outer Channel (highlighted in Blu in Figure 15) extends from Tokomaru Buoy to the extremity of the breakwater and consists of two main seabed makeups:

- Deep unconsolidated sediment over rock,
- Rock with little or no sediment overlay.

The majority of the outer channel is made up of deep unconsolidated sediment, estimated in places to be at least 30m thick, laid over rock. The outer (offshore) end of the outer channel is made up of papa rock with little or no sediment.

Due to how ships interact with the waves in this section of the channel EPL has a Static Under Keel Clearance in this section of the channel of 2.0m.

If the channel is to be deepened the outer end where there is Papa Rock would prove to be the hardest to achieve due to the need to dredge the Rock.

The outer channel is capital dredged to -10.4mCD (excluding tolerances).

7.4.2 Inner Channel

The Inner Channel (highlighted in Pink in Figure 15) extends from the Breakwater extremity to the Berths (Wharf 7 & 8), and consists of two main seabed makeups:

- Deep Unconsolidated Sediment over rock,
- Rock with little or no unconsolidated sediment.

Due to how ships interact with the waves in this section of the channel EPL has a Static Under Keel Clearance in this section of the channel of 1.5m.

Due to the proximity of the inner channel to the breakwaters and Butlers Wall any deepening of the inner channel will need to be carefully considered as it may affect the stability of these structures.

The inner channel is capital dredged to -10.4mCD (Excluding tolerances).

7.5 Turning Basin / Swing Basin

The turning basin at EPL (shown as "swing basin at the top of Figure 15) was originally created in the 1970's after the completion of Wharf 7 and export trade was moved from the Inner Harbour area to the then called outer port. This area is used to allow ships to be brought in forwards and turned (Generally on arrival) so that they can also depart forwards.

This area was further dredged to -10mCD in the 1990's but over time has sedimented up to approximately -8mCD. As ships at Eastland Port generally arrive in ballast this has meant that the turning basin has not needed to be dredged to full depth. However, as shown later in this report (Section 7.11) should container shipping develop then this would need to be dredged again to approximately -10mCD.

Due to how ships interact with the waves and the manoeuvres being undertaken in this section of the port EPL has a Under Keel Clearance in this area of 1.0m under the ship and to a distance of 25m from the furthest forward point. This additional distance is to allow the Ship, Tugs, and Pilot some working room when turning the ship.

This is illustrated in Figure 16 below.

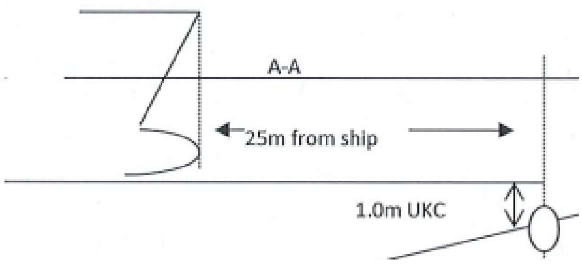


Figure 16 - Turning Basin UKC Illustration

7.6 Channel Level

A key factor when designing a port is the level (depth) of the shipping channel. The draught a ship can enter or depart the harbour is governed by:

1. Channel level,
2. Tide height (effected by weather patterns) and other meteorological effects (e.g. waves),
3. Allowable static under keel clearance (SUKC).

With the current channel level being a nominal -10.2 mCD, and the outer channel static UKC being 2 m, ships are draught and tidally restricted to entering or departing the port when they are "8.2 m draught plus height of tide above Chart Datum".

Ports normally ensure that ships can enter or leave the port on most high tides to prevent the situation of ships becoming captured (ship unable to leave the port). The ability to have ships depart on every high tide minimises the probability of this happening. However, it does mean the ships would be draught limited to the range of -9.9 m to -10.3 m based on the normal tidal range (Land Information New Zealand, 2020):

- 8.2m + MHWN = 8.2 + 1.7 = 9.9m
- 8.2m + MHWS = 8.2 + 2.12 = 10.3m

7.6.1 Outer Channel

Deepening the outer channel is a relatively simple activity from a construction stance as it is essentially excavating rock and sediment and has no impact on nearby structures. The outer channel for the purpose of this report is defined as the section between the Tokomaru Buoy and the southern breakwater extremity.

7.6.2 Inner Channel

The inner channel for the purpose of this report is defined as the section between the southern breakwater extremity and Wharf 7. It should be noted that this includes any localised widenings to enable a ship to manoeuvre from Wharf 7, around a ship at Wharf 8, and depart the port.

The deepening of the inner channel has a number of issues to address. These include the stability of:

1. Wharf 8,
2. Butlers Wall,
3. Breakwater.

7.7 Stability of Wharf 8

Wharf 8 has a maximum design dredge level of -10.9 mCD including all allowances (e.g. dredging and survey tolerance) (WorleyParsons, 2017), this equates to a maintained depth of -10.3mCD, which means that any dredging beyond this level would have the ability to impact on the structural stability of Wharf 8.

If the channel is to be deepened more than -10.3mCD, a clearance distance would need to be enforced between the face of Wharf 8 and the edge of the deepening to ensure that the stability of Wharf 8 is maintained. It should be noted that it is not normal for a berth pocket to be shallower than a channel that is in close proximity to it, however this is a situation that can be worked around with the correct processes put in place within EPL to manage ongoing capital and maintenance dredging.

7.8 Stability of Butlers Wall

The structure that forms the western side of the turning basin is known as Butlers Wall. This structure was originally built when Eastland port was being developed in the 1920's. It was remediated in the late 1950's and early 1960's by installing a new structure over the top of the older structure. The integrity of the wall is understood to be relatively stable with EPL having no significant concerns around its stability. However, deepening the channel beyond the current level may cause the southern end to become unstable. As a result, any changes to the channel need to consider the cost of addressing this and/or the strengthening the wall footings. The present channel design has been adjusted to minimise impacts on Butlers Wall.

7.9 Stability of the Breakwater

On top of their current condition, it is important to note that their stability is reliant on current channel design dredge level. As part of the WorleyParsons report into the breakwater stability (WorleyParsons, 2018) it was concluded that deepening the channel could be achieved to a maximum of -11.0 mCD (this excludes tolerances). As a result, this design dredge level should be reduced by allowing for survey tolerance of 0.1 m and dredge tolerance of 0.5 m.

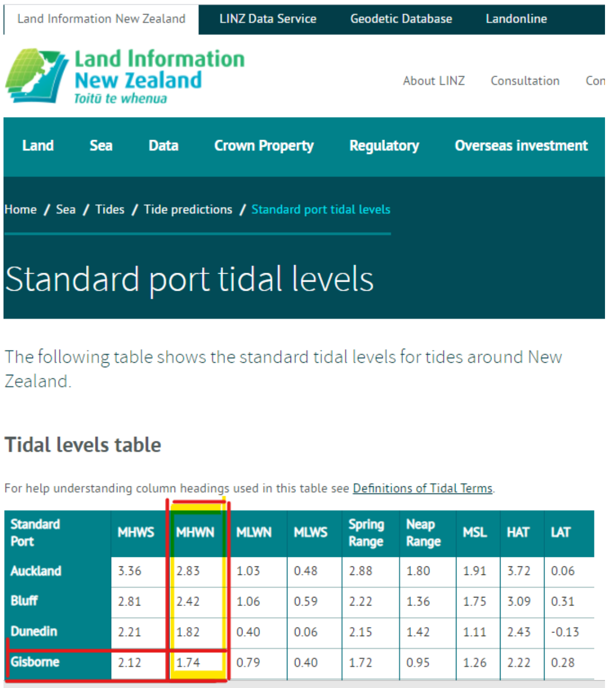
<u>This would give a maintained dredge level of -10.4 mCD. Should the level be required to go beyond this, significant modifications to the breakwater would be required to maintain stability. This cost would be on top of the costs required for breakwater maintenance.</u>

It should also be noted that more recent investigations suggest that the geotechnical parameters assumed in the previous study were non-conservative and therefore the value of -10.4 mCD may also be non-conservative.

<u>As the Twin berth project will not be addressing the significant breakwater modifications required to deepen the inner channel further this item defines the practical physical dredge limit of the Twin Berth project</u>

7.10 Shipping Channel

- Mean High Water Neap Tide = +1.7 mCD



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Standard port tidal levels

The following table shows the standard tidal levels for tides around New Zealand.

Tidal levels table

For help understanding column headings used in this table see Definitions of Tidal Terms.

Standard Port	MHWS	MHWN	MLWN	MLWS	Spring Range	Neap Range	MSL	HAT	LAT
Auckland	3.36	2.83	1.03	0.48	2.88	1.80	1.91	3.72	0.06
Bluff	2.81	2.42	1.06	0.59	2.22	1.36	1.75	3.09	0.31
Dunedin	2.21	1.82	0.40	0.06	2.15	1.42	1.11	2.43	-0.13
Gisborne	2.12	1.74	0.79	0.40	1.72	0.95	1.26	2.22	0.28

Figure 17 – Gisborne Tidal range LINZ Website (Land Information New Zealand, 2020)

- Current Channel Level -10.4 mCD
- Inner channel Current capital dredge Level = -10.4 mCD (excluding tolerances)
  - As noted in section 7.9 the inner Breakwater is physically limited in dredge depth.
- Outer Channel (Tokomaru Buoy to Breakwater) Static UKC is 2 m (Eastland Port, 1/2020)

- Inner Channel (Extremity of breakwater to Berths) Static UKC is 1.5 m (Eastland Port, 1/2020)

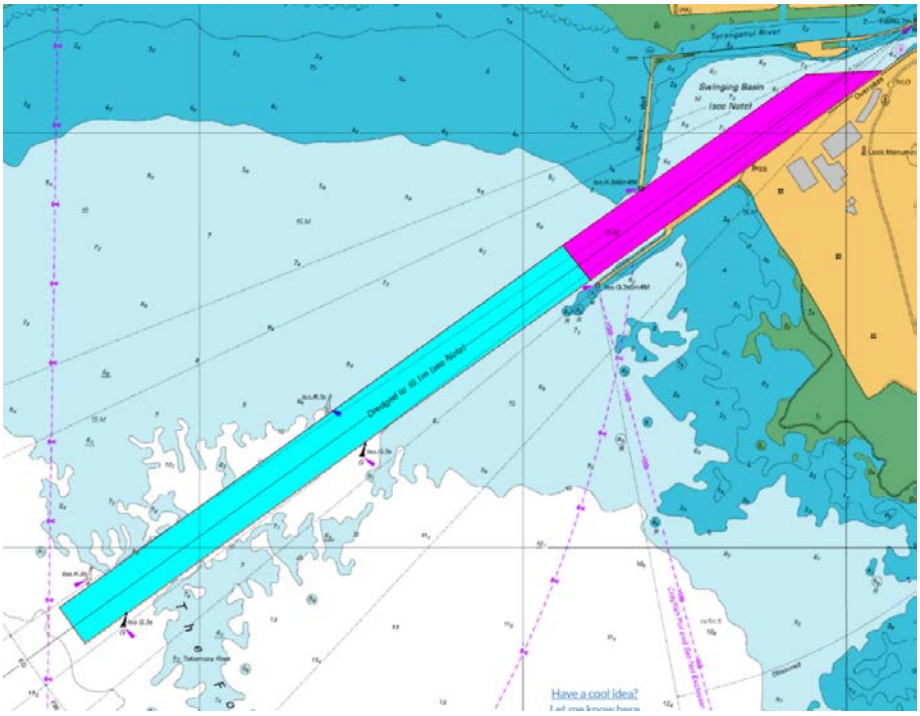

Figure 18 – Port Navigation Channel Sections

7.10.1 Options

As can be inferred, should the Port only wish to export logs and goods that can be shipped on the ships that comply with the current draught limitations of the Port, then this can be achieved without deepening the channel. This will limit the ships to only load to draughts that can allow the ship to depart with the respective forecasted tides. However, should the port wish to accommodate the future opportunities then the channel would need to be deepened as shown in Table 13. Required maintained level is calculated by the following formula:

Maintained Level = Tide - Draught – SUKC

Table 12 – Required Maintained Draughts for Design Ships

Ship	Tide	Draught	UKC Outer Channel	Maintained Draught Outer Channel (mCD)	UKC Inner Channel	Maintained Draught Inner Channel (mCD)
Maintain Status Quo	+1.7	10.1	2.0	10.4	*	*
Handymax Full Draught	+1.7	10.7	2.0	-11.0	1.5	-10.5
Supramax Full Draught	+1.7	12.8	2.0	-13.1	1.5	12.6
Container Ship	+1.7	10.9	2.0	-11.2	1.5	-10.7
Supramax Chip Ship	+1.7	10.5	2.0	-10.8	1.5	-10.3

*Due to the inner and outer channel being dredged to the same level, the current draught is limited by the outer channel. Hence this section is not applicable.

If it is decided to expand EPL to support two ships, the inner channel in the vicinity of the Turning basin would need to be excavated to the same level as the rest of the channel. This would allow the northern ship (on Wharf 7) to pass the southern ship (on Wharf 8) when departing.

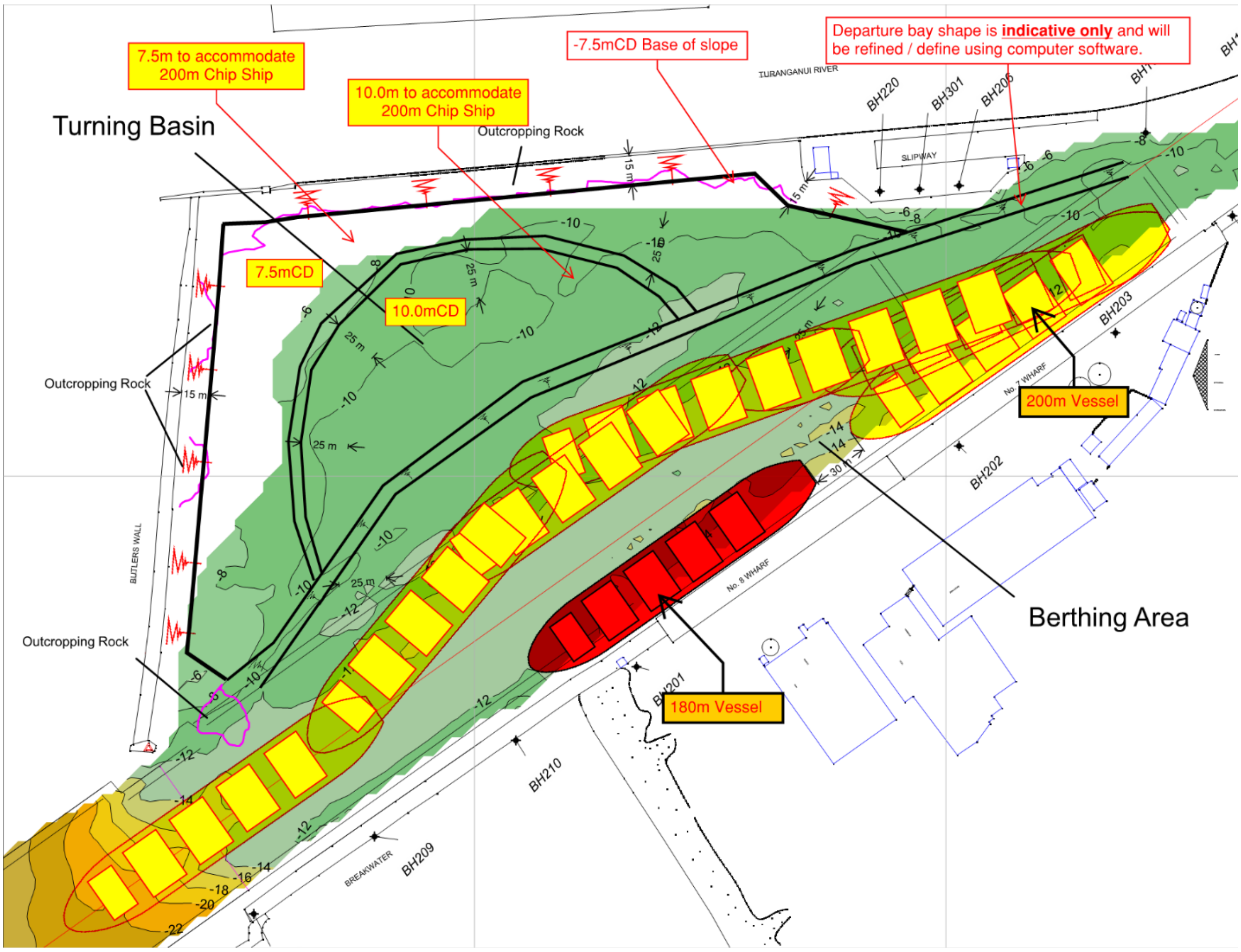

Figure 19 – Inner Channel Passing Bay – Indicative Layout

As shown in section 4.2 the twin berth project is needed for the port to be able to handle the forecasted log demand with the current draught restrictions and the ability to have two ships berthed at the same time. Table 13 provides the optimal additional dredging needed compared to the existing Maximum Maintained level for this to be alleviated.

Table 13 – Channel level compared to Maintained Draught

Ship	Handymax Log Ship	Supramax Log Ship	Container Ship	Supramax Ship
Draught	10.7 m	12.8 m	10.9 m	10.5 m
Maintained Level Outer Channel	-11.0 mCD	-13.1 mCD	-11.2 mCD	-10.8 mCD
Maintained Level Inner Channel	-10.5 mCD	-12.6 mCD	-10.7 mCD	-10.3 mCD
Maintained Delta Outer Channel (Current)	0.8 m	2.9 m	1.0 m	0.6 m
Maintained Delta Inner Channel (against -10.4 mCD)	-0.1 m	+2.2 m	-0.3 m	+0.1 m

Table Colours

- *Green = Additional dredging should not affect existing structures*
- *Amber = Channel can probably be able to be modified to accommodate additional depth*
- *Red = Channel deepening will definitely have impact on existing structures*

7.10.2 Channel Conclusion

As deepening the inner channel beyond a maintained depth of -10.4mCD (Section 7.9) will have significant cost impacts which are disproportionate to rest of the benefit of deepening the navigation channel beyond -10.4 m, then it is deemed that the deepening to allow for the 200m log ship (at full draught) would be discounted.

Therefore, based on this, the 200m Log ship (at full draught) will be discounted and the port should consider progressing with the following:

1. Apply for a consent to dredge to allow for woodchip and container ships to access the port (maintained depth Outer Channel = -11.0mCD, Inner Channel -10.4mCD).
   - If these opportunities eventuate then the opportunity can be assessed based on their individual benefits.
   - The cost impact relating to those opportunities would be the channel deepening and breakwater stability.
2. Set the design parameters for this project to be based on the current channel level.
   - This allows for an additional 8% JAS per year to be exported than the current forecasted maximum.
   - Significant costs are not incurred with minimal opportunity gains.
3. As the fully loaded 200 m log ship would require significant capital dredging and the system above would more than cope with the current forecasted peak JAS export capacity, then this ship load case should not be designed for.

It should be noted that the 200m (Supramax) logship at full draught has been discounted but a 200m (Supramax) chip ship has been accommodated. This in reality means that the port can still service as 200m log ship but that it will be draught constrained in principle to 10.6m (same draught as the 185m Handymax log ship).

7.11 Swing/Turning Basin Level

The Swing/Turning Basin at EPL was originally dredged to approximately -10 mCD. This understanding comes from a series of tests (geophysical (Marine and Earth Sciences, 2016) and trial pit excavations (email Bayley, M. to Aubourg, D., 2017)) to determine the level of rock that the port was originally dredged to. These tests confirmed that the base of the port had been excavated to -10 mCD over the majority of the Turning basin.

The most recent maintenance consent has applied for a level of -10.0 mCD, including dredging (0.5 m) and survey (0.1 m) tolerances, equivalent to a Maintained Dredge level of -9.4 mCD. Allowance for sedimentation would further reduce this level.

The Turning Basin has sedimented to varying degrees, generally getting shallower at longer distances from the wharf line, which has resulted in ships of varying lengths having different allowable forward draughts for Turning. EPL provided a list of the standard arrival draughts for the standard ships that frequent the port these values are:

- 170 m = 6.2 m
- 180 m = 6.0 m
- 185 m = 5.8 m
- 190 m = 5.8 m
- 195 m = 5.5 m
- 200 m = 5.0 m

Currently ships entering the Port are required to arrive in ballast (empty of cargo) to allow them to turn appropriately (static UKC = 1.0 m for turning basin). As a result, this can limit the availability of the port for the use of some ships which cannot ballast to the required forward draught (e.g. cruise ships, potentially container ships, some 200 m log ships). To maximise exporter flexibility, the basin could be dredged back to a level similar to the original (-10 mCD) allowing partially loaded ships to use the port.

It would also open up EPL to receive larger ships that have a greater forward draught than currently allowed. If this was done and a maintained level of -10 mCD is achieved over the whole Turning basin, then the arrival draught of ships could be changed to 10.7 mCD (10 m Dredge Level + 1.7 m Neap Tide – 1.0 m SUKC).

For the purposes of simplicity this section considers that ships arrive in draught and that they are level. In reality some ships when in draught are bow up (bow draught shallower than stern). However, as this varies according to the ship, we have assumed that the bow and stern draughts are the same. In reality, the ability for a ship to turn in the basin will be ship dependent and managed by the port and include factors such as partially loaded ships etc.

Figure 20 – Turning of a 185 m ship – Indicative Layout

To ensure stability of the surrounding structures, some distance is required from the base of Butlers Wall and the Diversion Wall, before dredging occurs. For the purposes of this report, it is expected that a distance of 20 m should be suitable. However, this distance needs to be verified.

Should the port wish to facilitate future opportunities then the level of the turning basin may need to be adjusted as follows:

Table 14 – Calculation of Turning Basin Draughts

Ship	Tide	Arrival Draught	UKC Outer Channel	Maintained Level Turning Basin (mCD)
Maintain Status Quo	+1.7	7.9	1.0	-7.2
Handymax Full Draught	+1.7	5.8	1.0	-5.1
Container Ship [1]	+1.7	10.9	1.0	-10.2
Chip Ship [2]	+1.7	7.5	1.0	-6.8

Notes:

1. This ship is 0.2 m deeper than current rock level (if ship arrives fully loaded). In reality it is unlikely to arrive fully loaded therefore there should not be an issue with this ship using the port.
2. The arrival draught of the woodchip ship has been assessed as 7.5 m based on the calculations below. Actual draughts should be confirmed in discussions with potential ship operators.
    - All the ballast tanks being full (23,816 mt)
    - All freshwater tanks being full (378 mt)
    - All the oil tanks being full (2,787 mt)
    - Total = 26,981 mt = Draught 7.5 m
    - Based on M.S. “Kutai Express”, Capacity Plan with Deadweight Scale.

Based on the required maintained depths in Table 14 and the discounting of the 200m Log ship from Section 7.4 the Table 15 below summarises the required depths needed for the turning basin.

Table 15 – Level of Turning basin for design ships

Ship	Handymax Log Ship	Container Ship	Woodchip Ship
LOA	185 m	175 m	200 m
Arrival Draught	7.9	10.9 m	7.5 m
Maintained Level	-7.2 mCD	10.2 mCD	6.8 mCD

With the above considered it is evident that the 200 m woodchip ship would only need a -7.5mCD maintained level and the loaded 175 m container ship would need a -10mCD maintained level.

Therefore, the turning basin could be further optimised to accommodate all the ships and minimise dredging. This can be done by battering the turning basin appropriately to the ships as shown below.

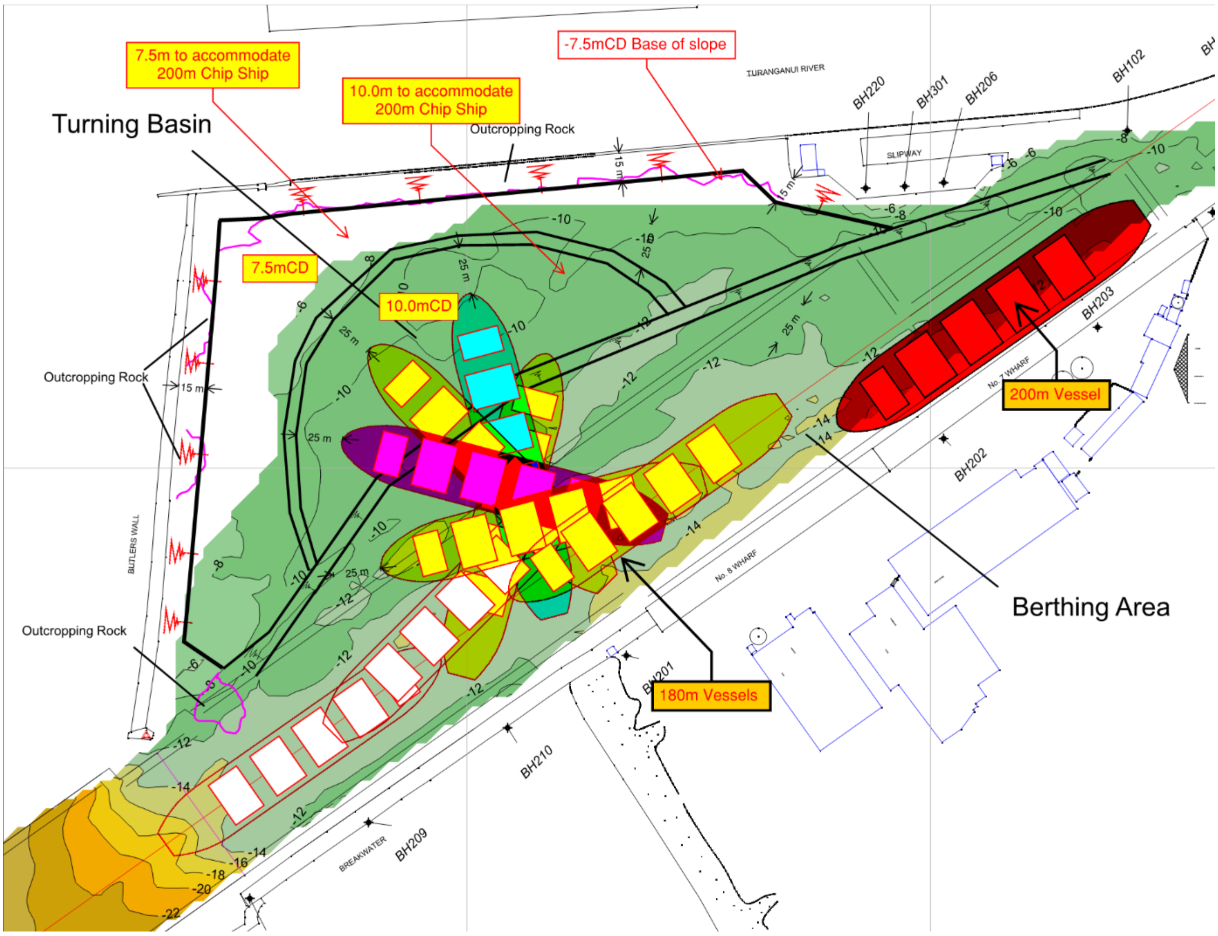

Figure 21 – Turning basin – indicative layout

7.11.1 Turning Basin Conclusion

By excavating the majority of the sediment in the turning basin and only minimal excavation of bedrock in high spot locations or for trimming to from a consistent basin, all the ships in the remaining design cases can be accommodated using the following maintained levels in a stepped formation:

- -10 mCD for the container ships,
- -7.5 mCD for the 200 m ships.

The above does mean that the container ship would be 0.2 m short on draught should it arrive fully loaded on an infrequent tide, however, it is anticipated that the port will be able to work with the shipping line to ensure that the ship avoids the lowest of neap tides that would prevent the ship turning in the port.

Therefore, the Design Parameters of this project should be:

1. Request a resource consent for the battered turning basin above
   a. -10 mCD for the 180m ships
   b. -7.5 mCD for the 200 m ships

7.12 Berth Pocket Level

The berth pocket level is affected by several factors which are all linked:

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

The first part in defining this, is to define the draught of the ship at departure. Based on the sections above, this can be summarised as:

Table 16 – Defining departure draughts

Ship Type	185m Full Draught	Container Ship	Woodchip Ship
Ship Name	N/A	MV Moana Chief	Kutai Express
LOA	185m	175 m	200 m
Departure Draught	10.7	10.9 m	10.5 m

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. This document is reviewed regularly and sets the limits that EPL is comfortable to have a ship sitting at berth under. Based on this the acceptable additional clearance that needs to be allowed under a ship is 0.7 m in the berth pocket (Eastland Port, 1/2020).

An additional allowance that needs to be made is the amount of sedimentation that is allowed in the berth pocket before maintenance dredging. EPL has set a sedimentation limit of 0.4 m.

The datum for assessing the level of the berth pocket is normally the lowest possible water level that the ship can be in the pocket at Lowest Astronomical tide, which for Gisborne is +0.28mCD (refer Figure 17).

When these design parameters are considered it sets the required berth pocket level as:

Table 17 – Finalised Departure Draughts

Ship Type	Current Log Ship	Container Ship	Woodchip Ship
LAT	+0.28 m	+0.28 m	+0.28 m
Depart Draught	10.7 m	10.9 m	10.5 m
SUKC	0.7 m	0.7 m	0.7 m
Sedimentation	0.4 m	0.4 m	0.4 m
Operational Dredge Level	11.6 mCD	11.8 mCD	11.4 mCD

7.12.1 Depth for the Future

However, 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 (formally WorleyParsons) to undertake a design berth pocket level assessment (WorleyParsons, 2018), which concluded that the maximum likely design berth pocket level (for fully loaded ships) should be:

1. Draught 10.8 m and Design Berth Pocket Level -12.5 mCD (see figure below).
   1.1. -12.5mCD is the Design Depth for engineering purposes
   1.2. Engineering may need to add a scour allowance beyond this

2. It was discussed with the EPL Marine team and currently ships are prevented from using the port due to weather on a regular basis (up to once every couple of weeks) however this was driven by the current channel constraints and the threat of ships being captured in port. Therefore, designing for a berth pocket restriction of 1 hour in 6 months would be conservative.

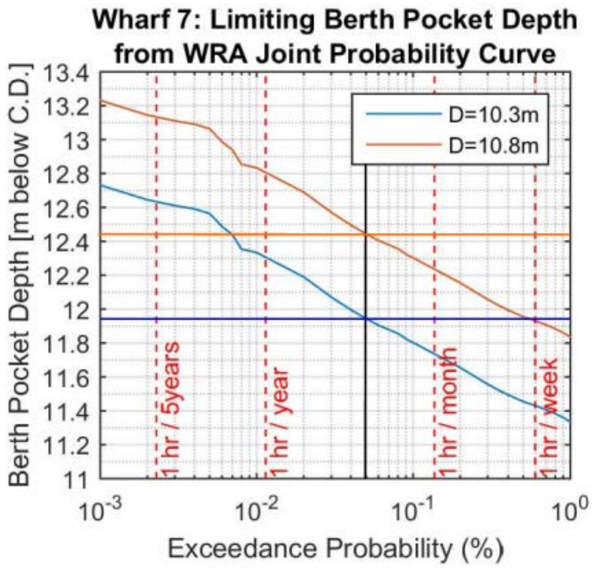

Figure 22 – (WorleyParsons, 2018)

7.12.2 Berth Pocket Conclusion

Therefore, it can be concluded that the following criteria should be allowed for the Berth Pocket levels:

1. Design the Quay structure for a design berth pocket level of -12.5 mCD (excluding scour)
    a. As Wharf 7 detailed design has progressed, it has been agreed to allow an additional depth of 1 m for scour allowance, which may include the placement of scour protection material
2. Apply for a consent to dredge to -12.5mCD.
    a. -11.8mCD Maintained Dredge Level
    b. -12.5mCD Design Dredge Level (allows for tolerances)

8. CONCLUSION

In conclusion it has been shown that the 200m fully loaded log ship should not be discounted due to its impact on the inner channel which would require the breakwaters and possibly Butlers Wall to be upgraded. All other cases can and should be accounted for. Theses being:

1. One 185 m log ship and one 175 m container ship at the same time
2. Two 185 m log ships simultaneously
3. One 185 m log ship with one 200 m log ship at the same time
4. One 185 m log ship and one 200m woodchip ship at the same time

As a result, it can be concluded that the wharfs be designed for the following lengths:

- Wharf 7 - 200 m ship
- Wharf 8 - 185 m ship

It is also a conclusion of this report that the following dredging levels be used for the various aspect of the work to come.

Area	Consent to Depth (incl. Tolerance) mCD	Maintained Depth Now mCD	Maintained Depth Later mCD
Outer Channel	-11.6	-10.5	-11.0
Inner Channel	-11.1	-10.5	-10.5
Turning Basin (200m Ship)	-8.1	-7.5	-7.5
Turning Basin 180m Ship	-10.6	-7.5	-10
Wharf 8	-10.9	-10.3	-10.3
Wharf 7	-12.5	-10.3	-11.8

9. REFERENCES

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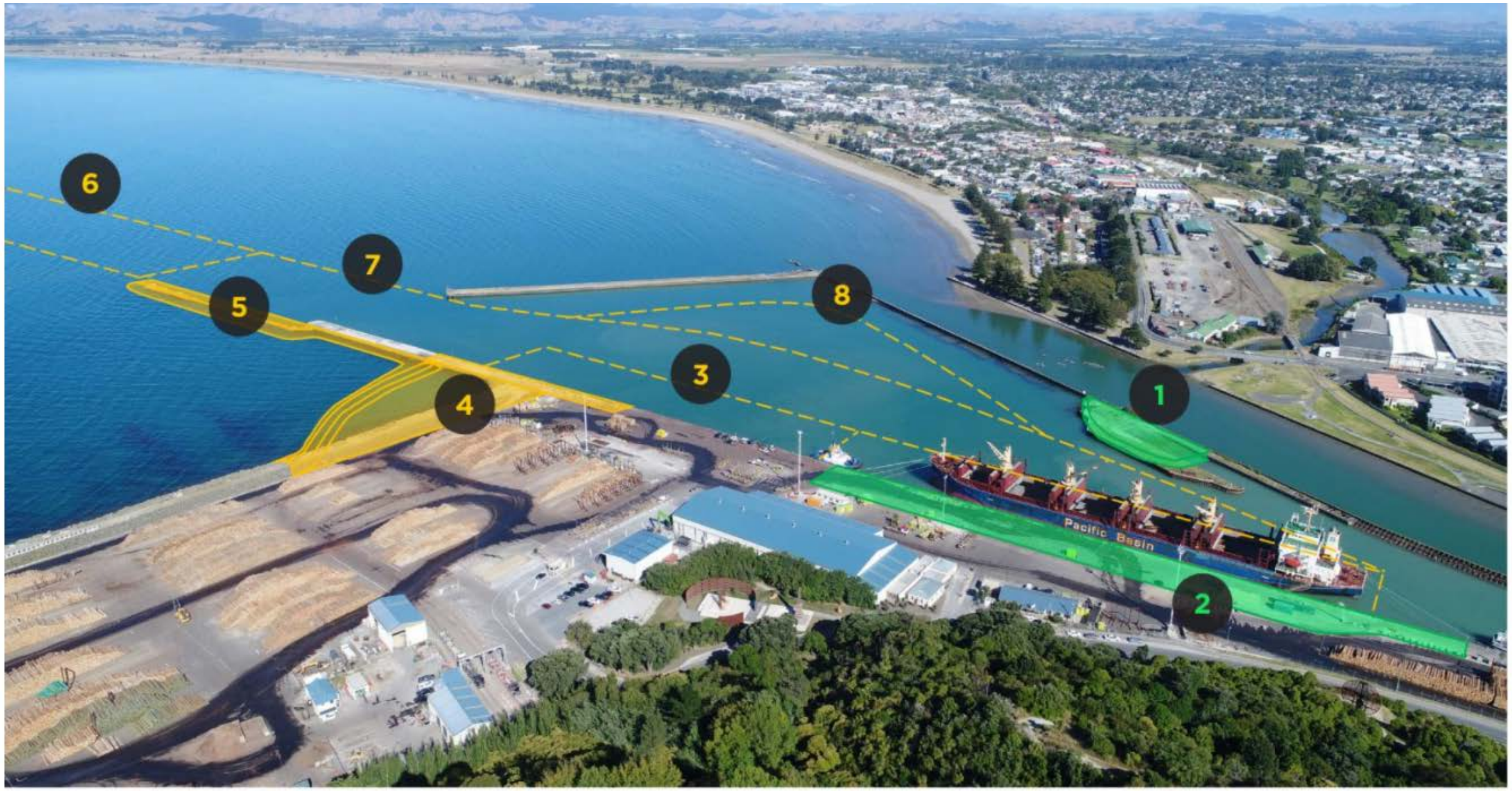
9.2 Table of Tables

Table of Figures

Appendix 1.
Twin Berth Projects Layout Plan



Stage one

1. Slipway reconfiguration
2. Wharf 7 rebuild 200 LOA, -12.5m

Stage two

3. Wharf 8 extension 185 LOA, -11.1m CD
4. 1.5ha reclamation
5. Breakwater repairs
6. Outer channel -11.6m CD
7. Inner channel -11.1m CD
8. Turning basin -10.6m CD