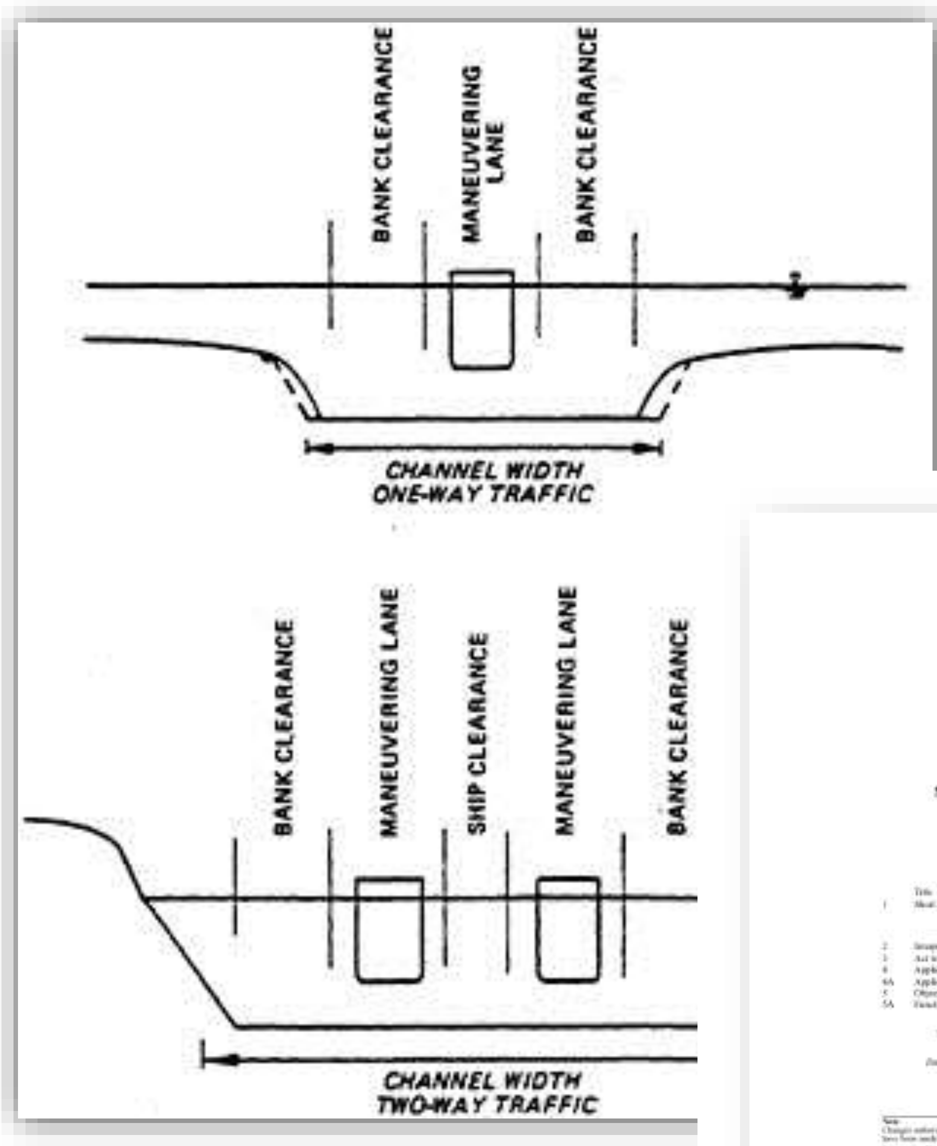


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Contents

Part 1

Part 2

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Whanganui Port:

Vessel Navigation Report

Considerations and possible implications of the size of vessels navigating at the Port of Whanganui.

Capt. J. V. Dilley, Master Mariner, Maritime Consultant and Harbourmaster.

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Executive Summary

The statutory functions and roles of parties for the management of the safe navigation of vessels within ports and harbours in New Zealand is clearly set out within the New Zealand Port and Harbour Marine Safety Code (The Code). The Code provides *"a voluntary national standard to support national and local legislation"* and *"covers all activities associated with the movement of ships entering, leaving and navigating within ports and harbours. It provides statements of good practice to assist all parties who are managing marine safety within ports and harbours to meet their obligations and exercise their powers effectively, and in a nationally consistent way. In order to foster continuous improvement, it promotes a systems approach to safety management based on risk".*

The primary roles and functions for ensuring safe navigation of vessels within ports and harbours therefore lie with port operators, and councils and their harbourmaster:

- Whanganui District Council and their harbourmaster has a role and function to, among other matters, use their statutory powers to manage and maintain the port so it is fit for its intended use.
- Whanganui Port 2010, an entity owned by Whanganui District Council, has a role and function in ensuring, among other matters; their port is in a fit condition for use by the ships that it serves, including the provision of adequate channels and berths.

To ensure compliance with the Code, and statutory responsibilities, the use of best practice, guidelines and standards will assist a council and port company to provide suitable infrastructure and facilities for the types and sizes of vessels that are to use a port.
A safety management system will need to be in place to effetely and continuously monitor, assess, mitigate and control risk. This safety management system will need to be focused on all aspects of the maritime operations and all pertinent factors that may affect the safe navigation of vessels and the marine operations at a port.

The exposed location of the entrance and port area at Whanganui Port, the flows experienced within the river and across the entrance, and the limitations of the existing structures, provide significant implications on the safe navigation of vessels. Standards and guidelines for the design provision of channels and manoeuvring areas, berths and structures ensure adequate facilities are provided in line with the Code, and the Council's responsibilities.

The current configuration of Whanganui Port provides:

- a suitable port facility for "a *maximum vessel dimension of 51 m length and 4.2 m draft"*[1]*; and*
- would, if suitable design calculations for the likely wharf loading requirements for the port structures and subsequent remedial work to those structures were undertaken, provide a port that may consider taking vessels up to a maximum of 100m length overall (loa), 23.3m beam and a draft of 4.2m.

The existing port layout would be extremely unlikely to provide a format for the manoeuvring and berthing of vessels of 180m loa that complies with the Code and the responsibilities of Council or a port company.

[1] Whanganui Port: Navigation and Operation Review, p. 28 Appropriate vessel size

Introduction

This report should be read in conjunction with my report Whanganui Port: Navigation and Operation Review which provides information on the port layout, natural conditions and limitations.

Recent proposals for the operation of large (180m length overall) ferries from Whanganui Port (the Port) require a review of the current capabilities of the Port to accept larger vessels and the regulatory framework and responsibilities that lie with each party in the management of maritime safety.

Purpose of this Report

The purpose of this report is to provide an overview of the:

- roles and functions of regulatory authorities and port companies in the navigational matters of port operations
- standards and guidelines for establishing safe vessel navigation
- practical parameters and barriers of vessel navigation and berthing
- vessel navigation and berthing at the port of Whanganui
- possible suitability of the layout of the port for larger vessel operations;

and to provide guidance on suitable maximum vessel size for the port in its current configuration

Port and Harbour Regulatory Framework and Best Practice

The regulatory framework and best practice for the operation and management of maritime safety matters within a port and harbour area are best encapsulated within the New Zealand Port and Harbour Marine Safety Code (the Code). Extracts from the Code, reproduced in the following section, provide the most pertinent information on the role, function and responsibilities of various parties in the management of maritime safety.

Port and Harbour Marine Safety Code

The Code is a voluntary national standard for the safe management of marine activities in ports and harbours, to support national and local legislation. It covers all activity associated with the movement of ships entering, leaving and navigating within ports and harbours.

The Code:

- promotes a systems approach to the management of safety to ensure that risks are identified and managed in a structured and sustainable way that fosters continuous improvement
- describes the framework for managing maritime safety in ports and harbours and summarises relevant aspects of the current law
- provides statements of good practice to assist all parties to manage maritime safety within their ports and harbours effectively, and ensure national consistency.

The Code is intended to apply, as a minimum, to any harbour area or commercial port with compulsory pilotage. Councils may also choose to apply the Code to any other enclosed or coastal waters in their regions that they consider to be harbours for the purposes of the Code

Maritime NZ led the Code's development in 2004, and all regional councils (councils) and ports have since adopted it. The Code was reviewed in 2016. Under the revised Code, a tripartite[2] Steering Group, a Working Group, and review panels will focus on ensuring the current standard of safety management is sustained, and continuously improved over the longer term. A new Secretariat position will support the Steering and Working groups in overseeing the on-going implementation of the Code and manage an agreed work programme.

The 2004 Code was supported by a number of guidelines for good practice. The Steering Group, supported by the Secretariat and Working Group will assess the need for guidance, developed in collaboration with port operators and councils. The current guidelines remain available for use. Relevant guidelines for the Port of Whanganui are:

- port and harbour risk assessment and safety management systems in New Zealand
- providing aids to navigation in New Zealand
- good practice for hydrographic surveys in New Zealand
- environmental factors affecting safe access and operations within New Zealand ports and harbours

There are broadly five steps to be undertaken once a party has committed to complying with the Code. These are:

- code application assessment
- risk assessment
- safety management system
- operational implementation
- audit, review and improvement

What the Code Covers

The Code covers all activities associated with the safe movement of ships entering, leaving and navigating within ports and harbours, including:

- the berthing and securing of ships;
- the safety of ships alongside a berth, on a mooring or at anchor;
- infrastructure, operating systems and practices that support these activities;
- the management of waterways in ports and harbours;
- protection of the marine environment; and
- the safe conduct of commercial maritime transport operations by port operators and councils within a port or harbour.

The main focus of the Code is on the safe movement of ships within commercial port and harbour areas. Although primarily concerned with the safe navigation of ships, some aspects also touch on broader maritime safety matters.

The Code does not cover:

- port operations on land;

[2] Maritime New Zealand, regional councils and port companies

- cargo handling on board a ship at a berth or at anchor, unless it affects the stability or safety of the ship, or safe navigation in the port or harbour; and
- port and ship security.

Maritime safety roles and functions in ports and harbours[3]

The Code provides information on the roles and functions of following parties:

- port operators;
- councils and unitary authorities;
- harbourmasters;
- Maritime New Zealand (Maritime NZ) and its Director; and
- the Minister of Transport.

Port operators

Port operators have a duty to operate, maintain and service their ports so there is no unnecessary risk or danger to people, the environment, or property on ships or at sea. Port operators that are port companies also have a statutory objective in the Port Companies Act 1988 to operate as successful businesses.

Each port operator is accountable for the safety of the port's marine operations.

Port operators:

- ensure that the port is in a fit condition for use by the ships that it serves, including the provision of adequate channels and berths;
- provide port users and the Harbourmaster with adequate information about the port facilities and operating limitations; and
- provide aids to navigation for the port.

In line with their assessment of any risks, they:

- mark, monitor and maintain the navigable channels necessary for the safe operation of the port;
- take reasonable care to ensure that stated water depths are maintained; and
- provide any necessary marine services such as pilotage and towage.

Councils

Councils have a statutory function to ensure maritime safety[4] within their regions, and may regulate ports, harbours, waters and maritime-related activities in those regions. The elected chair and councillors of the council are accountable for this function. In respect of the Code, the Council's focus is on port and harbour marine safety, which covers all activities associated with the safe movement of ships entering, leaving and navigating within ports and harbours, and includes navigation safety.

The council:

- ensures it is fully and regularly informed about the safe management of the region's harbours;

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[3] Whanganui Port: Navigation Safety and Operational Review p.20-21 provides further comment

[4] The term "maritime safety" is used here as that is the term used in Section 33C of the Maritime Transport Act in relation to the functions of regional councils.

- assigns executive and operational responsibilities for marine safety in its ports and harbours, including the appointment of the Harbourmaster; and
- arranges for the Harbourmaster to have direct access to the highest tier of management within the Council – this means the Harbourmaster can raise concerns about exceptional issues to do with harbour marine safety when necessary.

The regulatory powers of councils

There are four main powers available to a council to regulate ship movements:

- appointing harbourmasters;
- making and enforcing bylaws;
- carrying out harbour works; and
- removing wrecks, navigational hazards and abandoned ships.

How councils use their regulatory powers

In using their regulatory powers, councils (and their officers, including harbourmasters) should be guided by the following principles:

- Bylaws, and other regulation of ship movements in the waters of their regions focus on managing local conditions rather than matters already regulated at a national level.
- The exercise of regulatory powers is supported by clear policies and procedures in the Harbour Safety Management System (SMS) and has its basis in the Harbour Risk Assessment.
- There are clear policies on the enforcement of bylaws, regulations and rules.

Councils:

- use their statutory powers to manage and maintain their harbours so they are fit for their intended uses;
- provide adequate information about the condition of their harbours including prevailing environmental conditions, so users can determine whether they are safe;
- consider the safe and efficient operation of services and amenities provided in the harbour;
- make sufficient resources available to discharge their maritime safety[5] obligations under the MTA; and
- ensure that commercial considerations do not interfere with the effective discharge of their public interest, marine and navigation safety duties.

Specifically, they:

- keep hydrographic and hydrological records, taking reasonable care to ensure that stated depths are correct; and
- provide this information to the public and harbour users, including appropriate warnings if hydrographic and hydrological information is not current.

In line with their assessment of any risks, they:

[5] The term "maritime safety" is used here as that is the term used in Section 33C of the Maritime Transport Act in relation to the functions of regional councils.

- monitor and mark the navigable channels in the harbour in conjunction with the port operator; and
- exercise powers to remove wrecks and obstructions to allow safe navigation.

Councils may:

- direct that floating, submerged or stranded objects that could obstruct or impede navigation must be removed;
- take steps to remove wrecks where they could be a hazard to navigation; and
- remove abandoned ships.

Harbourmasters

Harbourmasters are appointed by the council to manage maritime safety[6] in their harbour.

Harbourmasters have:

- functions and duties to be exercised for the purpose of ensuring maritime safety in relation to ports, harbours and the wider waters of their region; and
- operational powers with respect to the safety of marine activities in those areas.

Harbourmasters may direct:

- when and how ships enter, depart or move within their waters;
- the position, mooring and placement of ships – including the use of tugs and other forms of assistance;
- how ships receive or discharge cargo;
- how cargo is secured if there is a risk of it being lost overboard and becoming a navigational hazard.

They may also regulate and control navigation whenever there is unusual or extraordinary maritime traffic.

To perform these functions effectively, the council ensures that an appropriately qualified harbourmaster is contactable at all times, so that the Harbourmaster can respond to exceptional circumstances or emergency situations, identify any risks and take necessary action in response to such situations.

Additional delegated powers

Under the MTA, the Director of Maritime NZ (the Director) can delegate powers to harbourmasters so they can:

- direct the Master of a ship to take a pilot, irrespective of any requirement for compulsory pilotage, or whether they hold a pilotage exemption certificate (PEC); and
- approve the management of aids to navigation

[6] The term "maritime safety" is used here as that is the term used in Section 33E of the Maritime Transport Act in relation to the functions of harbourmasters.

Maritime NZ

Maritime NZ has a statutory function to promote maritime safety and security, and protect the marine environment, both in New Zealand and in accordance with New Zealand's international obligations. Maritime NZ's functions include the provision of information and advice about maritime transport and marine protection, and the licensing of ships, their operations and crews. Maritime NZ also has oversight of all aids to navigation in New Zealand.

Maritime NZ's other legal responsibilities

Maritime NZ also administers other Acts with regard to ports and ships, including:

- the Maritime Security Act 2004 for ports and ships;
- the Health and Safety at Work Act 2015 on New Zealand ships; and
- the Hazardous Substances and New Organisms (HSNO) Act 1996 on board ships.

The Director of Maritime NZ

The Director (who is also the Chief Executive) has an independent statutory function to administer and enforce the MTA, and has various powers to enable this. These include enforcing obligations in the MTA and in maritime and marine protection rules relating to the operation of ships and commercial ports, including:

- licensing pilots and issuing PECs
- approving aids to navigation;
- directing that a pilot must be used;
- requiring councils to remove or deal with wrecks; and
- issuing directions with regard to hazardous ships.

The Director can also inspect and audit commercial port operations, and apply prohibitions or conditions.

The Minister of Transport

Under the MTA, the Minister can make rules setting mandatory national standards for the purposes of maritime safety and marine protection, and implement international maritime conventions.

The Minister can make rules relating to, amongst other things:

- pilotage;
- navigation safety;
- standards for the safe management of commercial shipping;
- carriage of dangerous goods;
- preparedness and response for marine oil spills;
- standards for port and harbour safety;
- standards for traffic separation and management schemes; and
- the implementation of international conventions.
- The Minister can also require a council to appoint a harbourmaster if it does not do so.

Whanganui Port

With consideration to the matters discussed above the primary roles and functions for ensuring safe navigation of vessels within ports and harbours therefore lie with port operators, and councils and their harbourmaster. In the case of Whanganui this is Whanganui Port 2010[1] the Whanganui District Council[7] and their harbourmaster.

- Whanganui Port 2010 has a role and function in ensuring, among other matters; their port is in a fit condition for use by the ships that it serves, including the provision of adequate channels and berths.

- Whanganui District Council and their harbourmaster has a role and function to, among other matters, use their statutory powers to manage and maintain the port so it is fit for its intended use.

The decision as to what size vessels the port is capable of receiving lies with the Whanganui District Council and their harbourmaster. This decision should be made in consultation with Whanganui Port 2010 and be based on best practice and guidelines for the manoeuvring of vessels, berthing of vessels and provision of navigational channels and any other relevant guidelines. The process for such a decision should be in line with the principles of risk assessment and safety management set out in the Code. This matter is discussed in the chapters below.

Whanganui Port: Castlecliff in its heyday

[7] Whanganui Port: Navigation Safety and Operational Review p. 24-25

Parameters of vessel navigation and berthing

Standards and guidelines

There are many standards and guidelines that may assist with the design, layout and construction of safe navigation channels, ship manoeuvring areas and berths. These standards and guidelines vary from the more simple to complex calculations allowing factors for ship design, speed, prevailing winds, bank clearance, navigation aids wave action, seafloor type, vessel cargo and longitudinal and cross currents.

The Permanent International Association of Navigation Congresses (PIANC) is the World Association for Waterborne Transport Infrastructure. *PIANC Report No. 121 - 2014, Harbour Approach Channels - Design Guidelines* provides guidelines and recommendations for the design of vertical and horizontal dimensions of harbour approach channels and the manoeuvring and anchorage areas within harbours, along with defining restrictions to operations within a channel. It includes guidelines for establishing depth and width requirements, along with vertical bridge clearances.

Similarly the Canadian Government provides guidance on shipping channels in their publication *Safe Waterways Part 1a GUIDELINES FOR THE SAFE DESIGN OF COMMERCIAL SHIPPING CHANNELS.*

As with the design of navigation channels the design of marine structures (berths, mooring bollards, dolphins and fendering) are the subject of similar standards and guidelines. These include;

- AS 4997- 2005 Guidelines for the Design of Marine Structures.
- BS 6349-1:2000 Maritime structures. Code of practice for general criteria
- BS 6349-4:2014 Maritime structures. Code of practice for design of fendering and mooring systems
- PIANC Guidelines for the Design of Fender Systems:2002

Standards and guidelines are a key part of the Code. Structures, berths and mooring arrangements for any vessels would need to be constructed and maintained to these or similar standards in order to provide a suitably secure berthage and navigation for vessels at a port. They also provide a council, or port company, a level of confidence that best practice and statutory obligations are being considered and complied with.

Channel width and vessel manoeuvring areas

The width of a channel is the subject of many factors. These will include;

- Vessel size
- manoeuvring characteristics of the vessel(s)
- effects of bank suction
- effects of wind
- effects of current
- whether the channel has bends
- crew operational experience
- availability of Aids to navigation (including Pilot)
- port infrastructure and plant.

With an absence of specific data for ship sizes and types, currents and wind etc. it is difficult to make detailed assessments of allowances and clearances and the use of a more generic model is appropriate. The guidelines can be used in a more general term, and thus provide an indication of minimum navigational channel and vessel manoeuvring area dimensions, for settled conditions, by the use of two factors;

1. A channel width, providing a constant minimum under keel clearance (UKC), of three times the vessels beam is required for a safe navigation channel. Such a channel would provide for the single direction of vessel navigation at any one time.
2. An area of a diameter 1.8 times the length of the vessel to provide a suitable manoeuvring or turning basin.

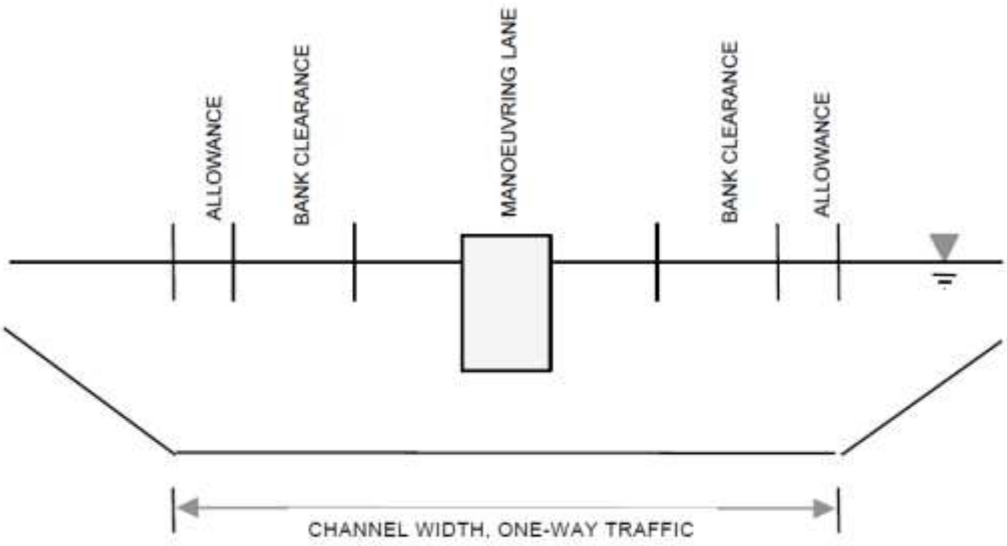

Figure A – Graphical representation of factors affecting channel width for single vessel navigation

Distances are taken from, and channel widths and manoeuvring areas are shown on, chart NZ4541 in Figure B. Use of the chart extract allows the ship manoeuvring areas to be seen in relation to the existing charted depths and drying heights for the port.

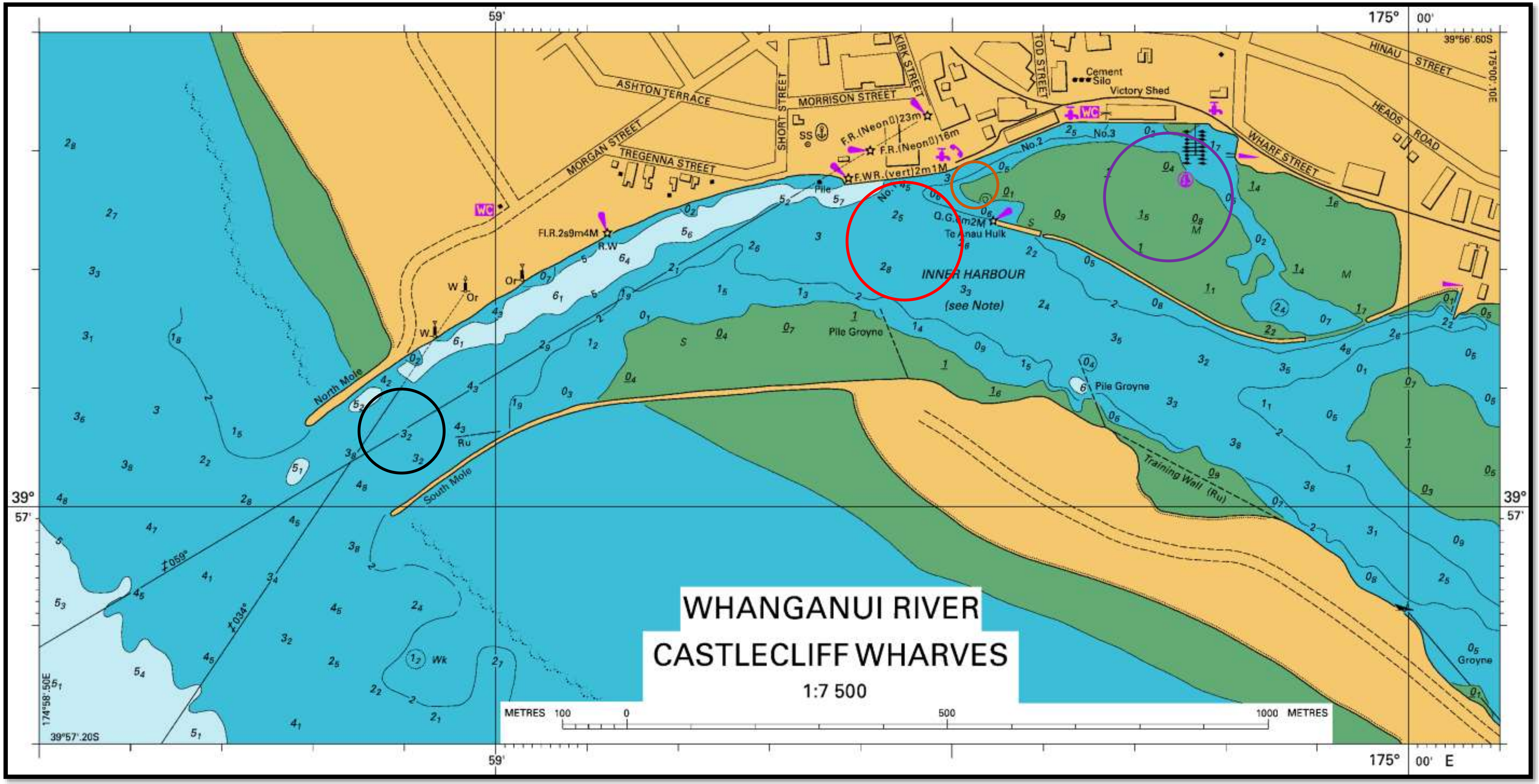

Figure B – Maximum non-specific vessel length and beam based on vessel manoeuvring area and navigation channel width.	
(red circle)	183m manoeuvring area for a vessel of up to 102m length (183m/1.8=102m)
(purple circle)	200m manoeuvring area for a vessel of up to 111m length (200m/1.8=111m)
(black circle)	130m width channel allowing a maximum vessel beam of 43m (130m/3=43m)
(orange circle)	70m width channel allowing a maximum vessel beam of 23.3m (70m/3=23.3m)

Channel depth

An indication of minimum depth of water required for a vessel to be able safely navigate can be determined by use of guidelines and experiences and practices in other ports. There are several factors that combine to make a ship moving through the water, being affected by waves and wind, have a deeper draft than the same vessel when it is motionless in calm water. Similarly there are several factors that need to be considered to make allowances for a seafloor that may not be quite as deep as believed in some places.

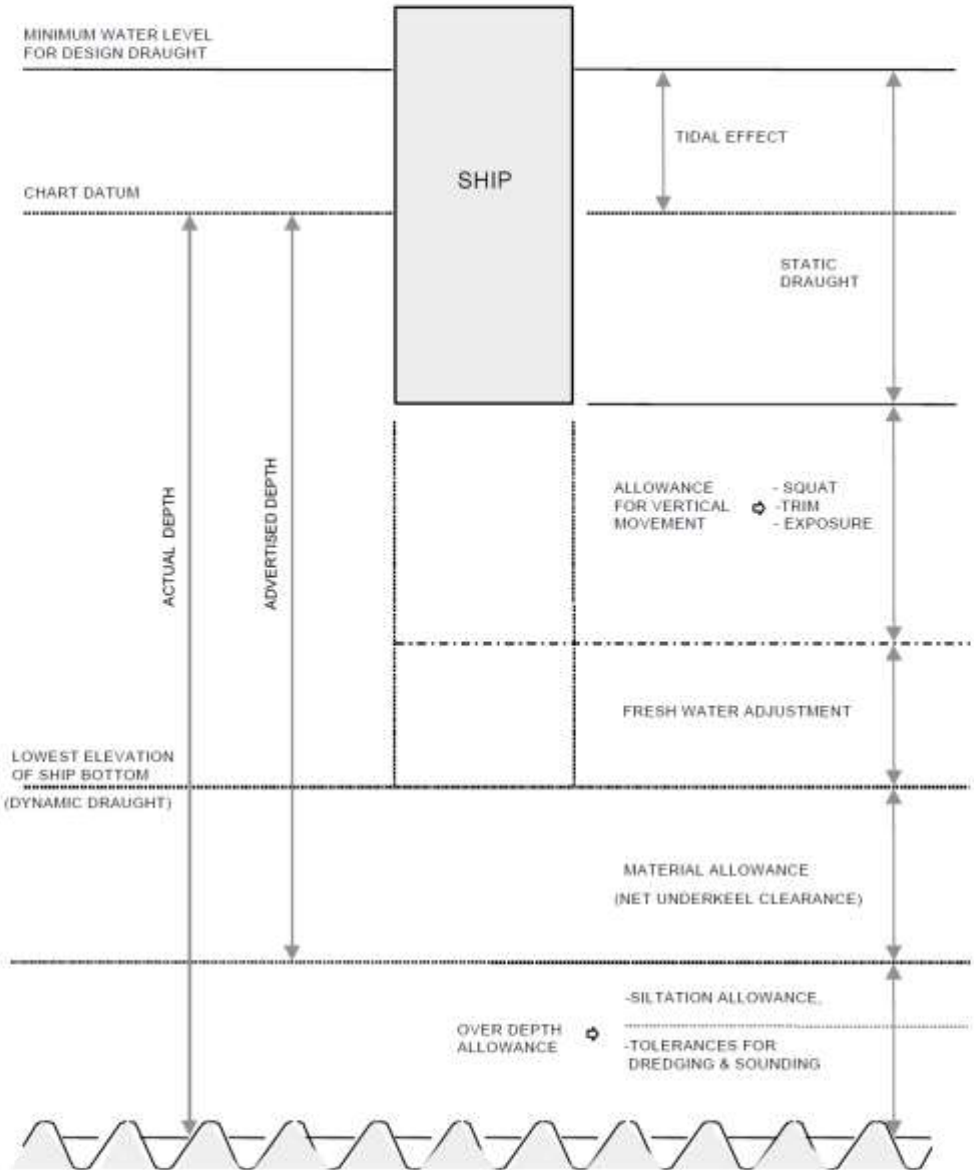

Figure C - Components of navigation channel depth

Figure C provides a pictorial representation of factors that will be among those considered in establishing a suitable channel depth. If we use a vessel of 181.7m length, 23.4m beam and 5.3m draft (MV Kaitaki, Interisland Line) we can establish indicative figures for some factors affecting channel depth.

The vertical movement components may be caused by the effects of wind or waves on the vessel. A vessel which pitches or rolls will increase its draft. Similarly a vessel experiencing a long period swell, as can be expected at the entrance to the Port, will rise and fall with those waves thus decreasing the clearance between the bottom of a vessel and the seafloor. For our vessel and the Port the following figures are indicative;

Allowance for a long period swell 2m (use half swell height)	1.0m
Increase in draft caused by vessel rolling to 5 degrees to port and starboard[8]	1.0m
Increase in draft caused by vessel pitching 1 degree[9]	1.6m

From the examples above we can see that a vertical movement of the vessel may cause a single increase in draft of up to 1.6m for the scenarios provided. Whilst multiple movements are likely to take place simultaneously we shall consider the single largest factor alone.

The Port is situated on a flowing freshwater river and the water at the port may be freshwater, seawater or a mix of both[10]. The calculation of freshwater allowance, the increase in a vessels draft when it passes from salt water to freshwater, varies with each vessel. An indicative figure of 2-3% of loaded draft[11] provides a figure of 0.1m (at 2% allowance).

The channel at the Port has been dredged previously and is known to fill in with silt both within the port, river and bar areas[12]. It can be assumed that this is likely to continue and that any dredged channel will require further dredging. To ensure a channel remains deep enough for its intended use it is common practice to make the channel deeper than is required. This over dredging allows the channel to be filled with silt to a certain point yet remain sufficiently deep for use. A very conservative figure of 0.2m may be used.

It is noted that the forecast lowest tide for 2017, which occurred on 29-30th March, had a level 0.4m above chart datum. As tidal levels can be significantly affected by meteorological events I have not included this factor. Allowances for such factors will increase the required channel depth.

MV Anatoki pitching in a seaway showing reduction of draft frd and increase in draft aft.

The Port is to be used at all states of tide, rather than at just high-water, we can remove the tidal height component from our investigation and focus on the channel depth at lowest tidal level.

[8] Indicative increase in draft due to small heel = half beam^2 + half beam^2 – 2 x half beam x half beam x cos heel^o
[9] Indicative increase in draft due to small pitching = half length^2 + half length^2 – 2 x half-length x half-length x cos pitch^o
[10] NP51 para 3.41 & 3.49
[11] Safe Waterways Part 1a GUIDELINES FOR THE SAFE DESIGN OF COMMERCIAL SHIPPING CHANNELS.
[12] NP51 para 3.41 & 3.52

If we now combine the allowances calculated above we find the following:

Static vessel draft	5.3m
Allowance for vertical movement	+1.6m
Freshwater allowance	+0.1m
Dynamic vessel draft	**=7.0m**
Over depth allowance	+0.2m
Channel Depth (no UKC)	**=7.2m**
UKC allowance	+0.5m
Required Channel Depth	**=7.7m**

The required channel depth, based on the factors above, is 7.7m. This is a minimum depth and the actual required depth is likely to be more when actual factors are taken in to account.

A channel depth of 7.7m would mean a channel would need to extend to approximately 860m further out to sea than the head of the existing Moles.

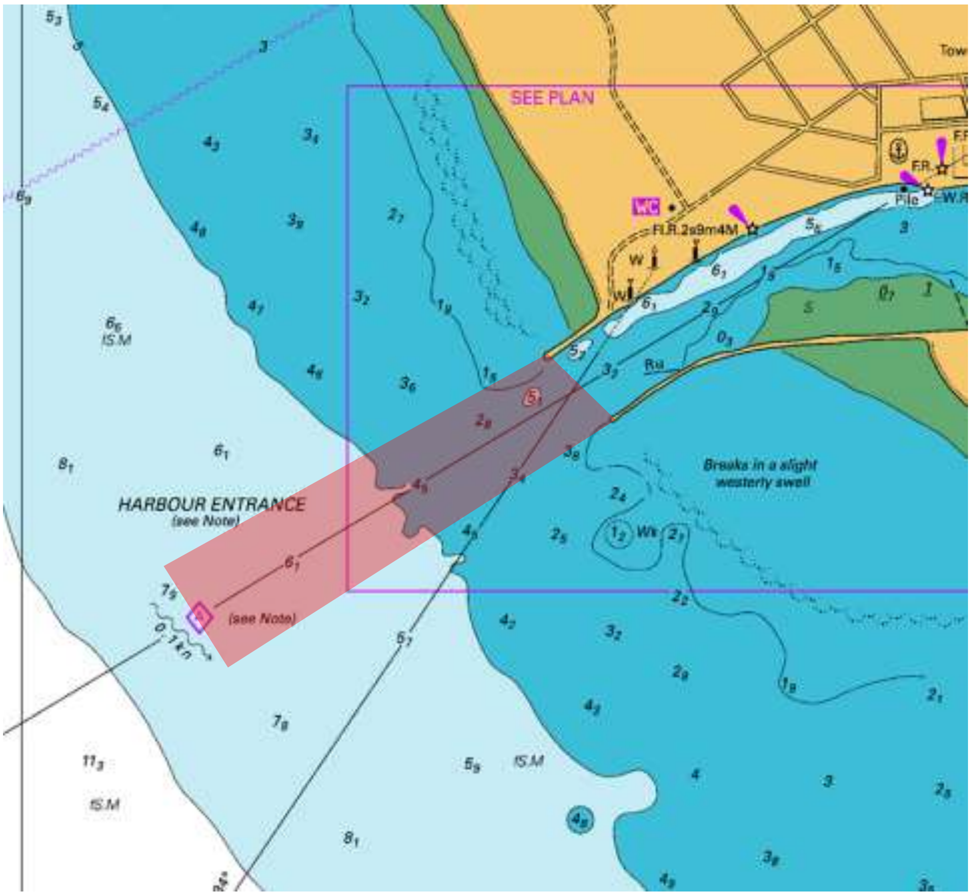

Figure D – Channel extent to seaward of Moles at 7.7m depth at CD

The matter of under keel clearance (UKC) is significant for most ports. Many ports operating in areas where weather conditions regularly affect sea conditions will use a 'dynamic UKC' system. This includes the use of real time measurements of meteorological conditions, tide and wave heights and modelled vessel motions including pitch, roll and squat to help ensure sufficient UKC is maintained.

It is difficult to provide a generic UKC calculation without a more detailed understanding of the environmental conditions at the Port and its approaches, and the specific vessels that may be visiting. The ports of Wellington and Timaru, both of which have exposed entrances, and are used by vessels of 180m loa use a figure of 1.5m[13] and 1.6m[14] respectively.

As the vessel enters the protected waters inside the port a lesser under keel clearance may be allowable as possible effects of heel and pitch will be reduced, however the effect of squat will play a greater role.

Practical Navigation safety considerations

Figure B shows the various areas of channel width, turning circle and channel depth, or drying height, in relation to the current layout of the Port.

Vessel manoeuvring

The manoeuvring of a vessel depends on many factors. Some factors are related to the vessel itself and include underwater shape, whether twin or single screw, thrusters and their capabilities, draft of the vessel, displacement, rudder type and specialised propulsion/manoeuvring systems. Similarly external forces on a vessel have a considerable effect on a vessels manoeuvrability. These forces include waves, tidal streams and currents, wind, effect of tugs.

Whanganui Port is located in an exposed coastline on a river mouth. There are many external forces at play here which will be far less significant in most other ports in New Zealand and around the world. The manoeuvring of vessels is therefore likely to require more space than may be necessary at other less exposed ports or ports with less extremes of wind, waves and current.

Whatever vessels visit a port there will always be limits to the operation of those vessels. These limits will include wave height and wind speed, and for the Port will need to include river flow. Whilst some mitigation may be put in place, by the use of tugs for berthing or turning a vessel, there will be a point where the potential risks of the operation become too great.

The process of turning a vessel, while stationary, is not simple. The use of the vessels main propulsion and rudder to effect a turn means a vessel will move forward as it turns. This requires the use of both ahead (forward) and astern (backwards) manoeuvres to slowly turn the vessel without moving out of the turning area. The vessels does not turn about its mid-point, rather a point about 1/3 of the ships length back from the bow (when manoeuvring ahead) and the stern (when manoeuvring astern). This manoeuvre becomes more complex when additional effects such as a restricted space or current and wind are added.

The turning of a vessel in the main stream (Figure B red circle) of the river provides the greatest opportunity for large clearances[15]. This does however leave a vessel trying to

[13] NP51 para 4.51
[14] Environment Canterbury Harbourmaster's Direction 16-1
[15] Tonkin+Taylor Memo 1 June 2017 p. 4 Reinstate Tanae Bank

maintain a position, whilst turning through 180 degrees, without getting swept up or down the river and out of the dredged turning area, or being caught by stronger winds. Tugs and vessel thrusters will assist in this turning process but limits on when the operation may take place will remain.

Turning a vessel within the Port basin (Figure B purple circle) provides an area where there is significantly less current flow of the river. This area is also likely to be slightly more sheltered from a west wind. The area available for turning is far less than that of the river area above and the maximum length of vessel able to turn will be less.

Structures and berths and port layout

The existing structures (moles, seawalls and berths) have been in existence for some time. The Port has historically taken coastal and smaller international trading vessels. The maximum size of vessel the Port caters to is listed in NP51, the New Zealand Pilot[16], as 100m loa, 20m beam and a draft of 4.5m. These maximum vessel dimensions are for a vessel manoeuvring at mean high water springs.

The information within NP51 for the Port appears to be significantly dated and I believe it is some time since it was last updated. The information does however provide an indication of the size of vessels the Port was receiving prior to its demise.

These dimensions would indicate the Port infrastructure was developed for vessels of up to about 100m loa that would enter and depart at high water. The structures required for this size of vessel and operation differ significantly from the structures required to accommodate modern larger vessels operating at all states of tide.

The dredging of deeper berths and channels alongside existing structures raises the issue of undermining those existing structure. The strength and integrity of older structures to withstand the loads imparted by larger modern vessels, operating in all conditions, is also an area that can cause issues. The dynamic and static loads imparted by a large vessel, with significant windage can be significant.

Having viewed the existing structures at the Port, and been involved with similar scenarios in the ports for which I am Harbourmaster, I believe it is unlikely the existing structures will be of a design or standard that can be brought in line with the loading needs of larger modern vessels other than those currently using the Port. The manoeuvring areas and channel widths, discussed below and shown on Figure B would, in all probability, require the replacement of all existing port structures and berths to ensure compliance with standards and guidelines.

Manoeuvring areas

It can be seen in Figure B that the largest manoeuvring area (red circle) that may fit with existing layouts has a diameter of 183m[17] allowing a maximum vessel size of 102m loa. This manoeuvring area lies within the area of the main flow of the river. While the flow of a river may assist turning a vessel in certain circumstances it can cause issues at most other times. In the case of a large vessel at the Port the vessel would need to be able to turn within the manoeuvring area without being swept downstream (or upstream) by the tidal or river flow.

A highly manoeuvrable modern ferry with high capacity thrusters would cope with turning in a restricted space far better than a less manoeuvrable vessel. As a ferry service relies on

[16] NP51 para 3.41
[17] Tonkin+Taylor Memo 1 June 2017 p. 4 Reinstate Tanae Bank

maintaining a schedule it would be necessary to have sufficient tug capabilities at the Port to ensure the vessel could operate safely in conditions where the thrusters were insufficient, or where an equipment failure, or adverse weather conditions meant assistance was required. Given the rate of flow of the river it is highly possible that tugs would be required for all ship manoeuvring.

As stated earlier the standards and guidelines provide minimum dimensions. The use of tugs would require additional space to ensure the safe turning of a vessel in the river flow. The amount of space would be dependent on the method in which they engage with the vessel, be that pushing alongside the vessel or pulling on a tow line.

A manoeuvring area within the relatively sheltered waters of the Port basin is 200m (purple circle) allowing a maximum vessel length of 111m loa. The advantages of the Port basin area are that it is less affected by the flow of the river and the tidal stream. It should be noted that this manoeuvring area, and the entrance to the Port basin channel width, are calculated with no vessels lying alongside No. 1, 2 or 3 berths. With vessels lying on these berths the available navigable width would be reduced and therefore the maximum vessel beam and length would be reduced.

The figures provided by guidelines for minimum manoeuvring area may be reduced where other factors come into play. Such factors may include exceptionally manoeuvrable vessels, significant thruster and tug capabilities, tidal flow, pilots, electronic piloting and ship positioning aids, sheltered waters, or ships not being bound by a schedule. Any reduction in safety margins must be carefully considered as it will be a conscious decision to reduce a level of safety and may be in contravention to national standards and responsibilities. In the case of the Port I would recommend larger clearances given the nature of the area located in strong river and tidal flows[18], and exposed to prevailing strong winds from the south to west quadrant[19].

Channel width

Figure B shows that a channel width of 130m (black circle) near the Moles. This would equate to a maximum vessel beam of 43m. At the entrance to the Port basin there is a channel width of 70m (brown circle) which would equate to a vessel beam of 23.3 m. The width of the Port basin is dependent on no vessels lying alongside No. 1, 2 or 3 berths.

The area of the Moles and the Bar are a very dynamic environment with significant wave and current activity. The nature of the wave action and the flow of the river, and cross currents at the Bar[20], will mean a ship will be liable to set sideways and be subject to yawing making remaining on course more difficult. A navigation channel in the area of such activity would be highly likely to need a greater width than those established as the minimum.

NZ4541, the nautical chart for Whanganui and its approaches, provides information on the tidal stream rates and direction at the entrance. This information indicates a tidal flow of up to 0.4 knots, and flowing parallel to the coast, will be experienced at times. A note on the chart warns mariners *'Tidal stream rates and directions are liable to vary subject to the rate of the river flow'.* NP51[21] provides information on the rate of flow of water at the entrance and within the river channel. Rates of up to 5 knots have been observed. These cross

[18] NP51 para 3.49
[19] NP51 p. 22-23
[20] NP51 para 3.49
[21] NP51 para 3.49

channel, and along channel flows will add significant degrees of difficulty to safely navigating a vessel in the channel and its approaches.

Information on wave and swell height is minimal. NP51 notes '*swell prevails throughout the year but is heaviest in autumn and winter'* and that *'Rough seas are common at all times of the year throughout the area, but especially S of* 40^0 *S'*[22]*.* The Port lies at 39^0 57'S. In winter 8% of reports from ships around New Zealand record seas of 3m or more[23].

Extending the Moles further to seaward, or creating a second set of outer breakwaters to provide sheltered waters in the approaches to the Bar area may help address these adverse effects of waves and current although may be impractical to erect and maintain.

Given the difficulties in navigating in the approaches to the Port, as described above and earlier in this report, the approach channel to the existing moles would need to significantly wider than the minimum parameters discussed in this report if vessels of 181.7m length, 23.4m beam and 5.3m draft are to be safely operated from the Port.

Channel depth

The channel depth required is likely to be slightly less within the sheltered waters of the Port basin and more in the approach areas to the Bar where a vessel is exposed to more significant wave activity.

At the indicative depth calculated of 7.7m the channel will need to extend 860m beyond the current Moles. Maintaining a channel depth in the active environment found between the Moles and this distance offshore may prove problematical. Extending the channel into more exposed waters will require a significant increase in channel width due to the stronger current and wave action as noted earlier. The extension of the existing moles, or addition of extensive breakwaters may assist in lessening infill within the channel.

Pilotage

Whanganui is not currently a compulsory pilotage area. Within Maritime Rule Part 90 it is listed as a pilotage area for future activation should the Director of Maritime NZ decides that compulsory pilotage is necessary in the interests of maritime safety or marine protection[24]. The area for pilotage would then be "all waters encompassed in an arc of a circle radius 2.65 nautical miles centred on North Mole Head light" for vessels of greater than 500 gross tonnes[25]. The introduction of vessels of 180m loa to the Port would be certain to trigger the activation of this compulsory pilotage area.

General considerations

The location of the Port in a river mouth provides issues of river debris in the form of tress and silt constantly affecting the navigable channels. These issues can be managed to a certain degree but do increase cost, and also increase possible frequency of incidents and/or delays.

The location of the Port provides no nearby shelter for a vessel that may arrive and be unable to enter due to deteriorating conditions, river in flood, or critical equipment failure on the vessel. Whilst modern forecasting and real-time monitoring may help to reduce this

[22] NP51 para 1.115 & 1.116
[23] NP51 para 1.115
[24] Maritime Rule 90.122
[25] Maritime Rule 90 Appendix 2

occurrence the desire to run a scheduled service will pose conflicting demands on the vessel masters and operators.

In my earlier report[26] I concluded *"I would recommend that a maximum vessel dimension of 51 m length and 4.2 m draft be set".* I believe this recommendation remains current. The layout of the Port may allow a future increase in vessel size should the infrastructure be assessed, upgraded and repaired[27] however that is unlikely to make the Port suitable for vessel over 100m loa in its current layout. This would be in line with the historical use of the Port and the guidance provided in this report.

In my considerations within this report I have allowed a clearance of 30m from moles, banks and seawalls to prevent undermining of those structures. I strongly believe that any attempt to excavate close to these structures will in fact undermine their likely shallower foundations. The change to a dredged channel to allow all tide access and manoeuvring for large vessels will be beyond the likely design criteria of those structures. The current port infrastructure was never likely to have been designed to handle modern vessels of 181m loa and is very unlikely to be capable of being upgraded or repaired to take such vessels. If vessels of 181m loa are proposed to use the Port for scheduled services then I would recommend that the port area is actually viewed as a clean sheet. A focused port design process could be undertaken to allow the optimal port layout to be designed and safety considerations appropriately addressed. This would include investigating alternative locations for a ferry terminal port.

Conclusion

The primary roles and functions for ensuring safe navigation of vessels within ports and harbours therefore lie with port operators, and councils and their harbourmaster.

- Whanganui District Council and their harbourmaster has a role and function to, among other matters, use their statutory powers to manage and maintain the port so it is fit for its intended use.
- Whanganui Port 2010, an entity owned by Whanganui District Council, has a role and function in ensuring, among other matters; their port is in a fit condition for use by the ships that it serves, including the provision of adequate channels and berths.

The decision as to what size vessels the port is capable of receiving lies with the Whanganui District Council and their harbourmaster. Any decision should be made in line with the principles of risk assessment and safety management set out in the Code.

The requirements of large ferry operations, running a scheduled service at all states of tide and weather, and having port facilities that meet regulatory and best practice requirements of the Code would see a complete re-design of the port layout. Additional considerations would need to include whether better or more suitable alternatives existed.

Having reviewed the existing port and its layout, applied general principles of vessel manoeuvring (in the absence of specific details), I find believe;

- that a maximum vessel dimension of 51 m length and 4.2 m draft is appropriate for the existing port layout and infrastructure; and
- the maximum vessel dimensions may be increased to 100m loa, 20m beam and a draft of 4.5m with the existing port layout if suitable design calculations for the likely

[26] Whanganui Port: Navigation and Operation Review, p. 28 Appropriate vessel size
[27] Whanganui Port: Navigation and Operation Review, p. 29 Infrastructure

wharf loading requirements for the port structures and subsequent remedial work to those structures were undertaken; and

- the existing port layout would be extremely unlikely to provide a format for the manoeuvring and berthing of vessels of 180m loa that complies with the Code and the responsibilities of Council or a port company.

Bio

In writing this report I have drawn on the knowledge, experience and qualifications gained in my maritime career. These include:

- **Qualifications:**
    - Class 1 (Deck) Master Mariner, Aug 1994, current STCW 95 (UK MCA)
    - Diploma Nautical Science (SCOTVEC)
    - Square Rig Master (Nautical Institute)
- **Seagoing experience:**
    - twenty one year's service on container and Ro-Ro vessels, tankers, square rig ships and general cargo/bulkers
    - eight years as master
- **Harbourmaster:**
    - five years' service for Canterbury managing the maritime safety of the ports of Lyttelton and Timaru, and cruise ship operations at the harbour of Akaroa and roadstead of Kaikoura
    - seven years' service as Deputy Harbourmaster for Auckland managing the maritime safety of Auckland and Manukau harbours
- **Successful implementation of the Code**:
    - Auckland and Canterbury including approval/confirmation of compliance with the Code from Maritime New Zealand and accreditation of the Safety Management Systems with ISO 9001
    - Chatham Islands for Chatham Islands Council
- **Provision of maritime advice:**
    - Department of Conservation for the Kermadec and Sub Antarctic Islands
    - Department of Internal Affairs for the development of a replacement port for Waitangi at the Chatham Islands
    - Bay of Plenty Regional Council for the navigation safety implications of the wreck of the MV Rena
    - Auckland Council for the safe berthing of large cruise ships (Ovation of the Seas) at Queens Wharf, Auckland.
- **Provision of Harbourmaster services to:**
    - Bay of Plenty Regional Council for the Port of Tauranga
    - Otago Regional Council for the Port of Dunedin including Port Chalmers
- **National on Scene Commander** for Maritime New Zealand