BEFORE THE OTAGO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of an application for resource consents for Project Next Generation
BY	**PORT OTAGO LIMITED**
	Applicant

STATEMENT OF EVIDENCE OF LINCOLN MURRAY COE
ON BEHALF OF PORT OTAGO LIMITED
Date 4 April 2011

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INTRODUCTION, QUALIFICATIONS & EXPERIENCE

1. My full name is Lincoln Murray Coe. I am General Manager Infrastructure (GM Infrastructure) for Port Otago Limited, a position I have held since 2008, having first commenced work for Port Otago in 2004.

2. I am a Civil Engineer, holding a Bachelor of Engineering (BE) from Canterbury University. I am a practicing Chartered Professional Engineer and a Member of the Institute of Professional Engineers New Zealand (IPENZ).

3. I have worked in the engineering, infrastructure and environmental areas of the ports industry in NZ for more than 12 years, with 4 years also spent in consulting engineering roles.

4. Prior to my current role, I was Technical Services Manager at Port Otago Ltd, as well as fulfilling roles as Asset Manager and Engineering Assistant with Port Nelson Ltd.

5. In my current role with Port Otago I am responsible for all infrastructure and engineering, including port development, maintenance and asset management as well as environmental matters.

6. Points of specific note in regards the relevance of my existing job are that I am responsible for :-
    a. dredging works which is a service we provide to the Port Otago Marine Services Division, and is managed by Harbour Services Manager, Mr Allan Sutherland.
    b. construction and maintenance activities associated with wharves, jetties, embankments and berths.
    c. managing our consents and environmental aspects of the operation, including community liaison.

SCOPE OF EVIDENCE

7. I have been involved with project Next Generation since its inception in 2007. I have been responsible for engagement of the specialist experts and advisors necessary to undertake the design and assessment work in relation to the project. I have been involved in the scoping of the majority of the works, execution of some and monitoring the progress and reviewing the results of all.

8. In developing project Next Generation, I have coordinated a multi-disciplinary process, where we have integrated commercial, logistical, engineering, environmental and community considerations to develop an overall project. By way of examples, and as explained in more detail by other witnesses, we have:
   a. Been very careful to design a channel alignment that is both safe and efficient from a ship handling perspective and which minimises effects on harbour ecology and other users of the harbour.
   b. Selected a new offshore disposal site which is sufficiently distant from shore and precisely located to ensure no, or at most minimal adverse effects on coastal resources, including the sensitive environments within Blueskin Bay.
   c. Respected the values and aspirations of tangata whenua, and commissioned KTKO to prepare a cultural impact assessment that we will implement, in good faith, its recommendations.
   d. Proposed a robust suite of conditions of consent.
   e. Committed to undertaking all activities in accordance with a comprehensive Environmental Management Plan; and
   f. Committed to openness and transparency of reporting and consultation with stakeholders throughout the planning and undertaking of the project.
   g. The scope of my evidence covers all of the areas I have just outlined.

THE CHANNEL AND BASIN DEVELOPMENT – General Introduction

9. The significant drivers for the channel and basin development at Port Chalmers are;
   a. the expected introduction of larger vessels,

b. the need to deliver operational improvements dealing with the growth in volumes of exports in particular, and

c. the need for operational flexibility in dealing with the growth in numbers and a change in the mix of vessels using the port brought about in part by the popularity of New Zealand as a cruise ship destination.

10. Importantly for reasons of health and safety, passenger experience and international security requirements it is becoming increasingly necessary to separate passenger and cargo movements within the port environs. The installation of a rock buttress and the extension of the revetment beneath the berths will provide a greater level security in the event of a severe earthquake.

11. The development of the channel and basin is likely to be carried out in a number of stages, some of which are interdependent and it may take as long as fifteen years to bring about the total project completion.

12. The timing of some elements of the project will be affected almost completely by the decisions made by others such as the international shipping lines. Port Otago is a service industry that needs to be able to service international cargo ships. Port Otago can not control the types of ships that are planning to call at the port.

13. Otago Harbour exhibits a long history of dredging and harbour improvement works which has played an important role in the history and development of the city and the province. This process has been continuous and ongoing since the 1800's, this project is the next step along that path.

FUTURE OF SHIPPING

14. As indicated in the prior evidence of Geoff Plunket, larger container vessels will inevitably come to NZ and Port Chalmers will need to be able accommodate these vessels in order to be able to provide the level of service required by the shipping lines. This is further expanded on by Mr Stuart Jennings and Mr Nigel Jones.

15. The dimensions of the vessels determine what channel dimensions are required to safely and efficiently handle these vessels. The following table shows the 3 key dimensions of the varying size vessels that I describe within this evidence.

Nominal Size	Max Draught	LOA	Beam	Displacement Tonnage	Typical Vessel Name
4100 TEU	12.5m	281m	32.2m	53,081	Maersk Damascus
5000 TEU	13.5m	294m	32.2m	68,187	Maersk Detroit
6000 TEU	14.0m	318m	42.8m	84,900	Maersk Karlskrona
6000 TEU	14.5m	300m	40.0m	84,771	Maersk Kendal
8000 TEU	14.5m	347m	43.2m	104,696	Sovereign Maersk

16. At present Port Otago handles the 4100 vessels, with a predicted incremental increase in the size over time to 5000TEU as a first step. That said we do need to be able to in the programme in case shipping companies do bring these vessels sooner. This means Port Otago needs to be able to respond quickly with a big dredge for the full channel dimensions in a short space of time.

17. The full channel design of 15m depth is capable of handling up to 8000TEU vessels.

DESCRIPTION OF THE EXISTING HARBOUR & PROPOSED WORKS

18. I provide a description of the existing harbour channel and then the proposed deeper and wider harbour channel prior to discussing in detail how the detailed design of the channel was undertaken. This design process is discussed in more detail in sections to follow. The reason for this is I believe it is important to have an overview of what the final channel design is to assist in understanding why many of the design choices were made.

The Existing Lower Harbour Channel

19. The existing lower harbour channel up to and including the vessel turning basin at Port Chalmers is shown on Figure 1, and extends over a distance of some 13kms landward of what is referred to as the “Landfall Tower”. This tower marks the start of the approaches to the harbour entrance, and will remain in the same position as it currently is even with a deeper and wider channel in the future.

20. The existing lower harbour channel is at a minimum declared depth of 13m below chart datum, increasing to 14.5m seaward of the north eastern extent of the “mole”. There are sections along the entire length of the channel currently that exceed these depths as a result of natural scouring action, particularly at bends.

21. The nominal or typical width of the existing channel is 183m, widening out up to 225m around Harington Bend and with widening in the immediate vicinity of the Port Chalmers port facilities to enable ships to be turned on either arrival or departure.

The Proposed Lower Harbour Channel – Deepening and Widening

22. The improvements to the lower harbour involve increasing the minimum declared depth of the channel to cater for the deeper draught of vessel, together with widening along the inner edges of each of the bends known as Harington Bend, off Tayler Point, Pulling Point, and opposite Deborah Bay to the Port Chalmers turning basin. The improvements are shown on Figures 2, 3, 4 and 5.

23. The volume of material to be removed from the Lower Channel, Swinging area and Berths is up to 7.2 million m3. This volume includes an allowance for overdredging to an average depth of 0.3m over the whole of the dredged area.

24. The design drawings and all project documents show and refer to the “declared depth” which is the depth that can be relied on for purposes of shipping movements and safe navigation. In order to achieve the declared depth, overdredging will occur up to 0.5 metres south of the mole end and up to 1.0 metre north of the mole end. The greater depth of overdredge

allowance north of the mole end is due to the larger sea-swells in that area increasing the movements of the dredge, which makes accurate depth control of the drag-head more difficult. The 0.3m overdredge allowance in the total volume calculation above is an estimate of the average depth of overdredge.

25. The widening of the channel takes the nominal width to a minimum of 200m, increasing to up to 250m around Harington Bend. These wider dimensions are required to cater for the increase in vessel length as well as width. The alignment of the channel is closely aligned with the existing centreline of the channel in order to minimise the volume of material removed, meaning that for much of the harbour the development of the channel will be largely confined to within the existing cross sectional envelope of the channel.

26. From the “landfall” tower to 2,000m shoreward or a point just north of the mole, the approach channel is to be increased to a declared depth of 17.5m below chart datum. A slight re alignment of the centreline of the direction of approach to the harbour entrance will require some widening of the channel to be carried out. This is confined to the western edge of the channel.

27. From that point the declared depth will be reduced to 16m below chart datum 5,600m landward of the tower, or to a point approximately two thirds of the way around Harington Bend.

28. Over the next 1,000m the bed will gradually slope up to achieve a declared depth of 15m and continue at that depth for the remainder of the channel up to and including the Port Chalmers basin.

CHANNEL DESIGN

29. I will now provide a detailed overview on the factors influencing the design of the channel.

30. The intent at the commencement of the design process, and one that I believe has been delivered, is to ensure the channel alignment remained as close to that of the existing channel as possible, thereby minimising the

amount of dredging to be undertaken and also the potential environmental effects of the development.

Tidal Windows and Commercial Drivers

31. The decision as to the channel depth is a technical, as well as commercial and environmentally sustainable one that strikes the balance between the amount of material to be removed from the channel, and the operational window that is available for the vessels to safely transit the channel.

32. Port Otago has determined that for the Port Chalmers operation, providing a 50% operational window for the 6,000TEU vessels transiting at their maximum laden draft of 14.5 metres, satisfies these requirements. The following examples are based on the 15m channel. Figures 6 and 7 show tidal windows for 2 different vessel draughts in a 15.0m channel.
    a. As Port Chalmers is an export destination, vessels usually arrive lighter draft (>1.0m less than maximum draught) therefore would be unrestricted in thier arrival.
    b. Departing with a 14m draught, the vessel would experience a maximum delay of less than 2hrs with an operational window of 86%.
    c. Departing fully laden at 14.5m would experience a maximum delay of less than 6 hours therefore providing an operational window of 55%.

33. When a delay does occur the shipping lines may need to make up this lost time in order to be able to keep their schedule which would incur additional costs to them.

34. This design decision, or determination of a 50% departure window is a very important factor in not just the design but in the whole of the project. We did consider designing, assessing and consenting a full 100% operational window, or “all-tide access”. This would have required a channel depth of 16m being 1m deeper than the proposal which would have increased the dredging volumes for the project to more than 11 Million m3.

Channel Design Process

35. The detailed technical design of the proposed channel design alignment and depth has been determined using internationally accepted design guidelines, including PIANC as well as the USACE guidelines.

36. The design process was undertaken by Port Otago staff including myself, Captain Hugh Marshall (Marine Services Manager) and Mr Allan Sutherland (Hydrographic Surveyor and Harbour Services Manager). We also sought specific advice and expertise from other experts and institutions.

37. A multi faceted process was used to establish the final harbour configuration with the design being narrowed down and improved through a series of iterations based on both theoretical as well as practical inputs. The following steps were involved;

    a. determining the physical environment that has the potential to affect the navigation of the vessels. This includes information on wind speed and direction, tides and water levels, wave climate, and currents.

    b. establishing the behavioural and navigational characteristics of the vessels, such as hull shape and dimension, vessel capabilities and control response including turning manoeuvres and acceleration and deceleration.

    c. establishing vessel clearance requirements such as underkeel clearance and vessel motions which can reduce underkeel clearance in places.

    d. preparing a preliminary design in the first instance adopting a theoretical approach using the PIANC and USACE guidelines.

    e. Undertaking two-dimensional scaled manual simulation runs using the larger vessels and tracing out the swept paths of the vessels. Allowing for adequate clearance outside the swept path allowed a proposed new channel width to be determined.

    f. Checking of the preliminary theoretical design against the two-dimensional manual simulations and confirming the channel concept design for further testing.

    g. With the channel concept developed, the design was then refined using real time simulation trials.

Final Design Depth

38. In determining the vessel sailing draughts in existing channel depth for sheltered waters (ie inside the mole end), the standard underkeel clearance (UKC) allowance of 10% is currently used for the majority of vessels in Otago Harbour, as is the case in the majority of Ports in NZ. This assumption was checked against the guideline values and was found to be consistent and appropriate.

39. In order to be able to accurately determine the additional depth required for the larger vessels responding to ocean swells outside the mole end and whilst turning through bends in the channel, we engaged specialist consultancy OMC International to undertake calculations to determine these additional depth requirements. Their work concluded the following:
    a. 10% UKC for these vessels within the harbour in sheltered water was adequate in all areas except for,
    b. Additional 1.0m of depth was necessary around Harington Bend due to the higher speed of the vessel at that point, and the roll or heel of the vessel as it executes the turn.
    c. Additional 2.5m of depth necessary at the exposed Entrance Channel north of the mole end, as the vessels can roll and pitch in larger sea states.

40. On the basis of the OMC work and using the nominal channel base of 15m (declared depth below Chart Datum), the three stepped channel profile of the final design was confirmed as follows:
    a. Port Chalmers to start of Harington Bend 15m
    b. Start of Harington Bend to Mole End 16m
    c. Mole End to Landfall Tower 17.5m

Final Design Alignment

41. The final design refinements and confirmation part of the design process was undertaken with full mission ship simulation verification. This was particularly relevant to the alignment of the channel, specifically the width of channel and the required widths of bends and turning basin. It did also

provide another method to confirm the determinations of the final channel depths above.

42. A simulator facility is operated by the Royal New Zealand Navy and located at the Devonport Naval Facility. It has been specifically tailored for the Otago Harbour conditions and allows for the effects of water levels, tidal range and wind and current forces as well as the hydrodynamic response and manoeuvrability of the vessel and speed as it transits the channel. The Kongsberg system and technology the simulator facility is based on is commonly used internationally for the purposes of pilot and ships master training as well as port development.

43. This simulator facility first set up in 2004 for Port Otago, has been used as a pilot training tool, as well as to enable a range of operational procedures to be trialled and refined before being applied in real life in Otago Harbour. Prior to this time, some of the existing pilots had used other vessel simulator facilities since the late 1990's.

44. More than 60 separate design runs were performed by 6 pilots over 7 days to confirm the adequacy of the selected channel design in varying conditions for varying manoeuvres. I was involved in providing all of the environmental information used as a basis for loading up on the system, and was in attendance during the simulation work. I therefore have a detailed understanding of the system, the technology and how it is used and applied.

45. In summarising this channel design section, a rigorous and robust process has been followed in accordance with international guidelines to design a channel that is safe and efficient whilst also being cognisant of economic and environmental matters.

Geotechnical Investigations & Materials to be Dredged

Materials Present

46. It is important to have a detailed knowledge of the materials to be dredged in order to be able to assess the likely methods to undertake the dredging and disposal, as well as the likely environmental effects resulting from each.

47. An overview of the testing locations and interpretation of the results of the investigations outlined below are shown on Figures 8, 9 and 10.

48. The starting point to aggregate the knowledge of sediments to be dredged was the long history of dredging records collated by POL as well as the former Harbour Board as a result of the earlier development and ongoing maintenance dredging activities. The local knowledge by staff members past and present who had undertaken much of that work was also important, which was one of the reasons for commissioning a short history of dredging that Mr Davis will discuss in more detail as part of his evidence.

49. An extensive and comprehensive geotechnical investigation was also undertaken by Opus in 2008, to determine the range of materials found in the harbour. Port Otago staff including Allan Sutherland participated in the scoping of the work as well as the actual sample collection which was done from the Port Otago floating barge "Rahi te Toa" which is a pile driving rig on a floating barge.

50. The geotechnical investigations confirmed that the material to be removed from the channel and to the required depth is a mix of sand and silt with a split of 62% and 33% respectively, the sand predominating, not unexpectedly, toward the harbour entrance. Small areas of clay (4%) and rock (1%) were also identified. The locations of the rock being at Acheron Head and Rocky Point.

51. Factors necessary for determining dredgability such as rock strength, as well as moisture content and plasticity for the silt and clay fractions were also collected. Dr Martin Single provides further more detailed description of the materials to be dredged within his evidence.

Confirming the volume to be dredged

52. One important aspect of the design was the assessment of the existing slope or angle of the batters, banks or side-slopes of the existing channels. Careful assessment was made along the full length of the channel to ensure that in the proposed design, the slopes of the batters were matched to be a similar angle to the existing, hence simulating the final long-term slope of those batters.

53. The slopes range from 1 in 12 at the entrance channel, 1 in 8 around Harington Bend and up to 1 in 3 in the vicinity of the Port Chalmers Basin. The differences are predominantly related to differing environmental factors such as tidal flows and wave energy.

54. Including this batter slope material in the total volume is important in order to able to accurately predict the potential environmental effects from the total volume of material to be removed the channel, and the actual extent of disturbance of the channel. Refer to Figures 5 and 6.

55. The total volume of 7.2 Million m3 is calculated by subtracting the design surface of the proposed channel from the existing surface which gives the final volume to be removed.

DREDGING METHODOLOGY

56. The key to undertaking the work successfully will be to be able to respond in a timely manner to the required channel dimensions for the larger vessels, with equipment that is cost-effective, and can operate efficiently and effectively within conditions of consent. In that regard we may have limited options to choose from for the sizes and availability of equipment that is capable and appropriate to do the work. Therefore the consents and their conditions need to be able to reflect this flexibility and be appropriately geared to different intensities of activity.

57. I will start by discussing the types of equipment to be used for various tasks and then discuss in more detail the differing intensities of activity being Incremental Capital Dredging and Major Capital Dredging, and Maintenance.

58. As an introduction to the types of equipment to be used during the execution of the project work, I will give a short presentation that includes a number of short video clips. Electronic copies of these slides and clips have been provided and can be produced in hard copy for the hearing panel if requested.

59. The most important aspects in relation to the content of the clips are the type, style and mode of operation and how the operation is undertaken

which are all similar to those proposed, rather than the size of the vessels which are bigger in all instances.

60. I also wish to show a series of photographs of the dredge New Era undertaking maintenance dredging works in the Lower Harbour. The photographs were taken from a fixed wing aircraft which circled around the dredge working as well as more widely around the harbour and peninsula area. In all photographs the dredge was working adjacent to Tayler Point at the time. Electronic copies of these photographs have been provided and can be produced in hard copy for the hearing panel if requested.

Port Otago Equipment and Experience

61. As with the geotechnical investigations above, Port Otago staff and personnel are highly experienced in undertaking both maintenance and development dredging. In addition to this expertise during the design and assessment stage of the project additional advice was sought from Stuart Hughes and Associates Ltd who assisted Port Otago in investigating both dredging methodologies and disposal alternatives. Dredging contractors Heron Construction Ltd, Van Oord and Jan de Nul all provided significant input on all matters associated with dredging.

62. Port Otago are fortunate in owing and operating our own dredging equipment being the 600m3 trailer suction hopper dredge New Era (TSHD) and the grab crane Vulcan. These 2 vessels have been working in Otago Harbour for more than 20 years and have been effective at completing both maintenance and development work. This gives the ability to be able to commence development works at a low intensity.

63. The New Era is capable of very effectively dredging all of the sandy types of material and also some of the silt materials. The more compact silts and clays may not be able to be dredged effectively or efficiently.

64. The Vulcan is capable of dredging the silty types of materials, as well as the rock when it is either highly weathered, or has been pre-blasted and is good for getting access to less accessible areas. The Vulcan could and would also be used to undertake dredging alongside the wharves where rock buttressing would be placed to improve the stability as well as on the

shallower parts of the swinging basin that the New Era or other dredges would be to deep to access. Material excavated with the Vulcan is placed into split hopper dumb barges which are then towed to the consented offshore disposal sites.

65. The limitation with these dredges is their size and scale in relation to the total project volume of 7.2 Million m3. To complete the full project would take more that 10 years which may be insufficient time to provide the necessary channel dimensions in time for arrival of larger ships. However, as I will discuss soon, both New Era and Vulcan can very effectively make good progress on the early stages of the dredging which is likely to be in sufficient time for the arrival of the next stage of larger vessels.

66. In order to be able to maximise the usage of both New Era and Vulcan it is proposed to increase the crewing with the potential to operate them 24/7. This is what the assessment of effects for this intensity of dredging activity has been based upon whereas in reality it is likely to be lesser than this taking into account items such as

    a. Vessel downtime for layup, maintenance and repairs.
    b. Vessel time away from Otago Harbour contract dredging at other ports.
    c. Whether to crew the vessel with 2 or 3 permanent crews.

All of these factors considered mean the percentage of time the dredge will be on the water “working” will actually be between 40% to 60%.

External Contractors Equipment

67. At some point in the development works it is likely that dredging equipment will need to be contracted in to complete the works.

68. A small trailer suction hopper dredge of similar size to New Era (ie less than 1,000m3 hopper) could be contracted in to work alongside (or in place of) New Era to undertake dredging works at an increased rate. I will describe the levels of activity and the definitions of Incremental Capital and Major Capital works below, with this particular activity being within the Incremental Capital works intensity.

69. A mid-size trailer suction hopper dredge is likely be required to undertake the works if the channel dimensions are required more quickly than the New Era (or similar size) can provide. In this instance a large trailer suction dredge would be needed to complete the works in a timely fashion.

70. In order to be able to make an assessment of the effects of a mid-size trailing suction dredge the team determined that the largest probable size of dredge that would be likely to be used on the job would be of a hopper capacity up to 11,000m3. The two key reasons for this assessment being;

    a. The physical layout of the harbour and the size of the dredge for safe manoeuvring, as larger dredges may have greater difficulty safely manoeuvring and navigating within the harbour and channel.

    b. NZ's remote location from other major dredging projects in the world and the very high costs of mobilising a larger dredge to NZ specifically for the job.

71. Therefore a largest probable dredge of 10,800m3 being similar to the Volvox Asia was chosen to assess the effects of highest intensity dredging being Major Capital works. Van Oord, the owners and operators of the Volvox Asia were very helpful in providing detailed operating information about the dredge which was used in the assessments.

72. Dredges come in all shapes and sizes and there are many TSHD's around the world with capacities ranging between 600m3 and 11,000m3 as well as much bigger up to 46,000m3. As I have previously discussed though Port Otago do not necessarily have a choice as to the contract dredge that is available at the time we need it, therefore flexibility is needed within the consents to be able to contract in the optimum size of dredge that is available at the time.

73. Mid-size TSHD's would be more powerful than the New Era and are therefore more likely to be able to dredge the compacted silts and clays. The loading times for a larger dredge is similar to that of the New Era, with the time to disposal site and return likely to be slightly faster (12-15 knots as compared with 8 knots).

74. The nature of TSHD's is that their activity is intermittent at any one location as they are mobile and when completed loading they sail to the disposal

site and return. As an example dredging at Harington Bend takes 80mins load time at the site then 1 hour to make the 22km return journey to the disposal site A0.

75. It is possible that a contract backhoe dredge is needed to undertake the rock removal, the deepening of the berths or the initial deepening of shallow portions of the swinging basin. The likely largest size of Backhoe to undertake the work is the Machiavelli owned and operated by Heron Construction Ltd. It has a 230T backhoe excavator mounted on a floating barge which loads into separate hopper barges.

76. Any contracts Port Otago sign with an external dredging contractor will have rigid and detailed requirements within those contracts to require enforcement of any conditions of consent, and as well as compliance with the Environmental Management Plan.

STAGES OF DREDGING

77. As Geoff Plunket has outlined, the current expectation is that container vessel size will increase in discrete steps to align with increasing import and export demand. Vessels are likely to increase from the current 4100TEU vessels to 5000 TEU's in the near term as a next step.

78. Following that in the future it would be likely that as a next step the shipping companies would to move to 5500 and ultimately 6000 TEU capability over time. The best information available at the present time is indicating that these steps will be incremental over time.

79. That said, flexibility is required in how the required dredging and disposal is undertaken in order for Port Otago to be in a position to quickly respond to vessel replacement decisions ultimately made by the shipping lines if they occurred quicker than expected.

80. The other reasons for consenting the total project and giving the flexibility to respond quickly to a shipping line decision to bring vessels quicker than expected is the time taken to gain consents as well as the time required to mobilise dredging equipment from other parts of the world. Gaining consent for a discrete "stage" could take a number of years, and mobilising appropriate dredging equipment from elsewhere in the world could take

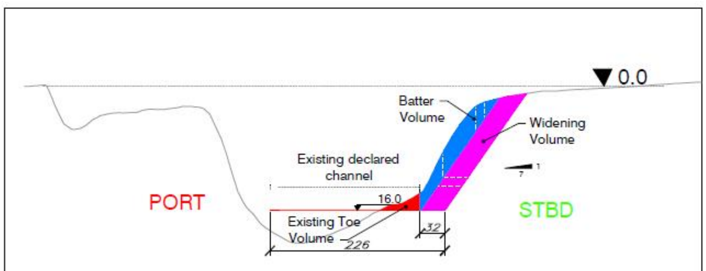
between 12-24 months depending on what other projects are underway in other parts of the world.

Stage 1 - 14.0m Toes & Batters

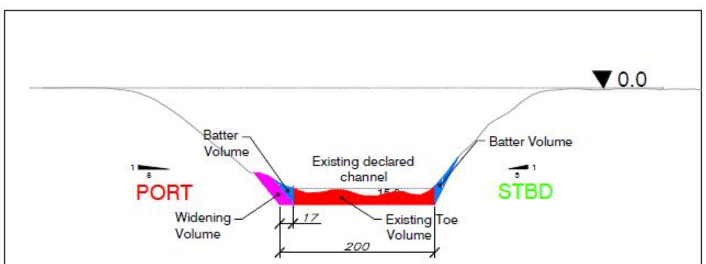
81. The most immediate and effective way of accommodating a vessel increase to 5000TEU capacity is to dredge the invert of the existing channel between the existing channel toelines to a nominal depth of 14.0 metres. This would give a similar tidal window for the 13.5m draught vessel as exist at present for the 4100 vessels sailing with a 12.5m draught in a 13.0m channel.

82. Much of the channel is already at these depths. It has been estimated that the volume of material to be removed to achieve the channel depth of 14.0m between the existing channel toe-lines is in the order of 1.0 Million m3. A depth of 13.5m results in approximately 400,000m3 of material to remove.

83. In conjunction with the material removed from between the toe-lines, the initial stages of dredging will also involve the removal of a portion of the material at the base of the sloping batter. This is illustrated on the following diagrams which are diagrammatic only as they have a 10 times exaggerated vertical scale.



Harington Bend - 5,000m From Fairway Beacon



Tayler Bend - 9,000m From Fairway Beacon

84. This staged approach will require ongoing dredging at the base of the batter slopes in order to maintain a safe navigable channel, due to the gradual adjustment of the batter slopes that will continue to fall naturally to the toe of the deeper channel until a stable profile is achieved.

85. This is estimated to involve the removal of an additional 1.5 Million cubic metres (m3) of material over time to achieve the 14.0m channel depth at the existing toelines and channel width. The need for ongoing dredging from channel side adjustment is not uncommon following dredging and will reduce over time.

Stage 2 - Widening of Harington Bend & Swinging Basin

86. With a more gradual increase in the size of vessel, the need to widen the channel at Harington Bend and the Port Chalmers swinging basin would likely be able to be deferred until the 6000 TEU vessels need to be accommodated.

87. The volume of material to be removed from these two areas of the channel is approximately 775,000 and 1,000,000 (m3) respectively. It is expected that this work would be undertaken after a channel depth of 14.0m is achieved.

88. The reason for this is that the length of the ship in particular but also the beam determines the need to undertake this work and this is not expected until vessels of >5000TEU.

Stage 3 - 15.0m Toes, Widening & Batters

89. The volume of material to complete the widening in the remainder of the channel and, to take the toelines down to 15.0m and then the material from the batter slopes as well would be approximately 2.9 Million m3.

90. Dredging of the channel beyond 14.0m would be undertaken either in an Incremental Capital dredging operation or a Major Capital dredging operation. Again as similar to the 13m to 14m stage, initially the deepening of the channel toe to the required depth will be undertaken with progressive removal of batter material as the channel adjusts to the increased depth.

91. The method and timing for undertaking this last stage of the channel deepening will be dependent on the shipping company requirements with the increased channel depth to match the vessel size requirements at the time, and due to the greater volumes involved, would likely required a large contract dredge to complete the work.

Summary of Dredging Stages and Volumes

92. The above stages can be summarised in the following table.

Depth or Width Stage	Approx Stage Volume	Cumulative Volume
13.5m Channel - existing toes	400,000	400,000
14m Channel - existing toes	600,000	1,000,000
14m Batters only	1,500,000	2,500,000
Widening - Swingin Basin / Harington Bend	1,775,000	4,275,000
15.0m Channel - widening and batters	2,900,000	7,175,000

DREDGING INTENSITIES & DEFINITIONS USED

93. As outlined above the deployment of dredging equipment and methodologies ultimately selected for the development, will be a function of the timing of the requirements for an increase in channel capacity. This will be determined by the demand from shipping lines, the availability of appropriate dredging plant and an available budget.

Incremental Capital Dredging

94. The Incremental Capital dredging is really an extension of the maintenance dredging programme and would involve the removal of the maintenance dredging volumes as well as incremental improvements using a combination of dredging plant.

95. Incremental Capital Dredging will still be a low intensity activity being more similar in scale and intensity of operation and effects to the existing maintenance dredging regime compared to a Major Capital dredging operation.

96. The maximum amount of material proposed to be removed with Incremental Capital dredging is estimated to be in the order of 1.45 Million m3 per annum, although more likely to be less than 1.0 Million m3 per annum.

97. To achieve this volume would require changes from the Maintenance dredging operation that would include:

a. The New Era (or dredging plant with similar capacity) working extended hours (in excess of a typical 8 hour working day) through multi shift crewing;

b. Bring in additional plant, for example a second trailing suction dredge of a similar size to the New Era. (<1,000m3 hopper).

c. The use of barge mounted backhoes or grab dredges (such as the Vulcan) to undertake preliminary shallow dredging at Harington Bend, the eastern extent of the Swinging Basin, as well as the removal of rock at Acheron Head and Rocky Point.

d. The purpose of this shallow dredging is twofold. Firstly to provide sufficient water depth to enable use of a trailing suction dredge and secondly, to remove harder materials unable to be removed using a trailer suction dredge.

e. The shallow areas will be worked from backhoe or grab dredge moored or stationed directly alongside the area to be dredged. A barge mounted or grab excavator will remove the material and load this either into dumb barges or a self propelled barge such as New Era. Barges will be tied up directly along and on the seaward side of the excavator platform.

f. Similarly, the dredging and removal of material at the berths to start the berth stabilisation work outlined later would form part of the incremental capital works.

98. Any additional dredging equipment would be in response to a specific demand from the shipping lines for increased depth.

99. It is envisaged the 14.0m Toes and Batter phase comprising 2.5 Million m3 will be undertaken at this intensity, estimated to take between 5-6 years.

100. Detailed assessments of the effects of the Incremental Capital works have been undertaken by the experts.

Major Capital Dredging Programme

101. Any Major Capital dredging programme will involve the removal of the balance of the 7.2 Million m3 of material not otherwise removed through the Incremental Capital dredging operation.

102. A Major Capital dredging operation would mostly likely provide for the remaining full development depths and widths of the channel and would occur should there be an immediate need to accommodate container vessels with a container carrying capacity of 6000 TEU or greater.

103. For a Major Capital dredging programme Port Otago would contract a larger trailer suction hopper dredge from Australia or Asia. This contract dredge would likely have a hopper size of less than 11,000m3 and have an ability to dredge and dispose of material in the order of 1 Million m3 per month. Hence the full 7.2 Million m3 of the project could in theory be completed in approximately 7 months.

104. As described above, for a Major Capital dredging programme to take place, a certain amount of work would still need to be completed by “New Era” as well as barge mounted backhoe or grab dredge. This work includes gaining sufficient water depth to operate the larger contract trailer suction dredge and also to remove harder materials that are unable to be removed using a trailer suction dredge.

Blasting to facilitate removal of rock

105. At two locations within the harbour channel namely Acheron Head and Rocky Point a comparatively small volume of rock, estimated to be a total of 25,000m3 is to be removed.

106. The rock will require drilling and blasting to fracture and dislodge the material for it to be able to be removed by a grab dredge. The drilling of blast holes would be from a floating barge moored in the channel.

107. Port Otago is familiar with this type of operation, having previously carried out rock removal at a number of locations within the harbour. Similar conditions to previous operations have been offered in the conditions of consent and Environmental Management Plans.

108. One such project was in late 1992 and early 1993 the Beach Street Berth was deepened by some 1.3 metres, involving the removal of 7,500m3 of rock (solid volume). Residential properties were located as close as 150 metres from the site in that instance, where as the separation to the nearest residential property at the proposed locations is 250 metres.

Maintenance Dredging

109. On completion of the capital dredging program or potentially at any stage during the dredging program, capital dredging may cease or pause for a period of time, in which case maintenance dredging of the depths achieved to that point would be required.

110. Over recent years the average volume of material removed in maintenance dredging has been in the order of 150-200,000 m3 per annum, despite the New Era being capable of removing well in excess of this amount.

111. Maintenance dredging within the harbour is a permitted activity to depths specified in the Regional Coastal Plan, with disposal to three consented nearshore sites for a total volume not exceeding an annual volume of 450,000m3.

112. A renewal of this consent is to be sought but that renewal does not form part of this application meaning the amendments to the maintenance disposal consent that are now applied for will expire on 1 December 2011 and require to be renewed after that date.

Disposal of dredging

General

113. The alterations to the channel, berths and swinging basin areas requires approximately 7.2 Million m3 of material to be removed from the channel and disposed of in a suitable location. The materials being a mix of sand, silt, clay and rock as I have described previously.

114. Options and alternatives for the reuse of the dredged materials were investigated in detail as part of the assessment process. Onshore and

offshore options were considered, including those for reuse, recycling or beneficial use.

Reuse, Recycle, Onshore Options

115. Alternatives for onshore options were considered as follows :-

    a. use as a construction material,
    b. use as a land fill,
    c. a source of roading sub base,
    d. in the formation of reclamations and,
    e. a source of coastal renourishment material.

116. The first three points I raise above are 3 possible commercial reuse options. However this is not practical as there are no commercial markets where the material would be competitive when compared with existing materials used at the present time. In addition even if such markets existed they would only be able to take small portions of the total dredged material.

117. Reclamation would require resource consent and there are no authorised reclamations within Otago Harbour we are aware of. Port Otago are also unaware of any commercial demand for major reclamation works within the Otago Harbour that would benefit from receipt of significant portions of dredged sand material.

118. An alternative was raised in a number submissions, and Port Otago have had some discussions with a group of submitters who believe that the silt material could be used to reclaim intertidal portions of the Upper Harbour area to restore muddier interdial habitats that have been lost as a result of developments works in the past.

119. Any reclamation, harbour restoration or alternative disposal to land for the benefit of the community would, of necessity, involve clear justification of the necessity for that development, and detailed design work and assessment of the total effects. In addition strong support from the whole of the community would be required to successfully carry such a project through, particularly given the size and scale of such a project required to take significant portions of the dredged material. Again given the volumes

of material required these options are not considered viable for the disposal of all of the dredged material.

120. Port Otago has provided sand as part of its maintenance dredging operation, largely to satisfy a demand associated with coastal renourishment on St Kilda and St Clair Beaches. On those occasions management of the operation was required in order to provide a limited quantity that is able to be stockpiled in order for it to be transported by road to the final destination.

121. It is considered that the occasional short term, low volume demands within the Dunedin area can continue to be satisfied with the occasional load or loads being diverted as part of the Incremental Capital or maintenance dredging programme.

122. In summary the volume of sediment available, even as a result of the lesser intensity incremental capital dredging, far exceeds the potential volumes which could realistically be used for any of these alternative uses. Hence the only practical and viable option is for the majority of the material from Incremental Capital and Major Capital Works to be disposed of at sea.

Disposal to Sea – Existing Inshore Sites

123. There are records of dredge spoil from the harbour being disposed of at sea since 1914 although it has probably occurred at a much earlier date as dredging has been an integral part of the ongoing development and maintenance of Otago harbour since the 1860's.

124. The three sites that are currently in use as the consented maintenance disposal sites, being Heyward Point, Spit and Shelley Beach have demonstrated they are suitable for dredge spoil disposal.

125. Prior to 1985 all dredged material was placed at the Heywards Point site, this included material derived from both development and maintenance dredging. The Heywards site tends to be preferred during rough weather as it can often be calmer than the other sites due to the greater depth of water (18 metres) available.

126. In 1985, the Spit disposal site was first used, requiring the dredge to spend less time steaming. Although it was the preferred site for many years an active management decision to reduce the spoil disposal to that site was made 3 years ago to reduce the amount of spoil build-up at the site.

127. A third location, South Spit (Shelley) Beach was added as a further option in 1987. Sediment was placed here to assist in renourishing the beach which was suffering from erosion. This site has limitations in that only sand seaward of and including Taylers Bend is able to be disposed of. This is to ensure that material moving onto the beach is of a similar composition to the sand that already exists there.

128. In total the combined volume able to be disposed of to the three sites as consented is limited to 450,000 cubic metres.

129. It was acknowledged from the outset by the assessment team that due to the sheer volume of material associated with the major capital dredging it was considered that an alternative disposal location for significant portions of the disposal was required.

SELECTION OF OFFSHORE SITE A0

130. Studies to identify suitable sites for the disposal of dredgings commenced in 2007 during the preliminary investigations stage of the project which I will discuss in more detail later. Figure 11 attached shows the location of the offshore disposal site.

131. This first stage of site selection involved Studies to identify suitable sites for the disposal of dredgings commenced in 2007 during the preliminary investigations stage of the project which I will discuss in more detail later. This first stage considered the following key matters.

   a. Avoiding areas of conservation interest, protected marine areas and areas of significant ecological value.
   b. Avoiding significant effects on fishing and aquaculture.
   c. Avoiding effects on recreation including sailing, surfing and boating.
   d. Avoidance of shipping routes.
   e. Effects of disposal on currents and waves.

f. The likelihood of sediment being re-transported and causing effects on other areas such as beaches and estuaries.

g. Distance from dredging work and consequential travelling costs.

h. Siting of disposal in areas of similar natural material in order that re-colonisation of existing habitat will occur as quickly as possible following cessation of the disposal activity.

132. When the constraints maps from the above were overlayed, the resulting map showed potential areas where the operational factors would be most optimal and the adverse effects would be minimised. This mapping then guided the 2 initial choices of disposal site (A1 and A2), which were the starting points for the more detailed modelling and other assessment work.

133. The modelling steps and iterative process that was undertaken during the modelling to determine the final A0 site is described in more detail within the evidence of Dr Rob Bell. This modelling included

a. plume dispersion enable assessment of ecological communities,

b. wave modelling to assess any shoreline effects from a the higher disposal mound.

c. Sediment transport calculations to be able to determine sediment transport and movement away from the disposal site.

134. Two separate peer reviews of the modelling were undertaken, which Dr Rob Bell will discuss in more detail.

135. In addition to the modelling work, parallel biological surveys of the benthic and other habitats were also undertaken to confirm the nature of the potentially affected areas, the final part of this process being the 2010 survey that is referred to in the evidence of Dr Mark James.

136. In summary, the final choice of the A0 site as the offshore disposal location was optimised by considering a large number of influencing factors in order that the potential for disposal material to impact on Blueskin Bay, northern coastlines and Otago Peninsula, fisheries aspects as well as areas of special or unique biological communities would be minimised.

Management of Disposal Operation

137. It will be necessary to maintain the flexibility for Port Otago to manage the disposal operation between these inshore sites and the new offshore sites.

138. The New Era will be limited to using A0 during calmer sea conditions. Its smaller size and limited freeboard would otherwise expose the vessel and crew to unacceptable risk at the more exposed offshore site.

139. The inshore sites are restricted in volume (in view of the total project volume) therefore it will be necessary to take material to A0 even during the Incremental Capital dredging work. They are also restricted as to the amount of silt to be placed there with a minimum percentage of 90% sand specified.

140. Rock is not permitted to be disposed of at A0.

141. Material as a result of Major Capital dredging is to be disposed of at A0 only.

142. All of the reasons above are why the disposal will require the sites to be managed in an integrated manner.

WHARF EXTENSION & FISHING JETTY

Overview

143. With the growth of containerised cargo that has been experienced by Port Otago since the development of the first stage of its second container berth referred to as the “Multipurpose Berth” in the early 1990’s, as well as the increasing number of vessels generally required to be serviced at Port Chalmers, the company is forecasting that it will need to undertake a further extension to this wharf.

144. The extension to the Multipurpose Wharf is 135 metres long and varies in width from 28 metres to 37 metres. The variation in this width is due to the change in alignment of the top of the rock slope of the existing reclamation. It is shown in Figures 12 and 13 which show both the location and design details of the wharf.

145. The Fishing Jetty extends 30 metres into the Coastal Marine Area ("CMA") and is separated both vertically and horizontally from the Multipurpose Wharf. In addition there will be a fence at the northern end of the Multi-purpose wharf to separate the structures and maintain the required level of port security.

146. Both the wharf extension and the Fishing Jetty are within the area of the CMA that it is necessary that Port Otago occupy in order to carry out its port related commercial undertakings.

The Need for the Wharf Extension

147. The present multipurpose wharf is a structure approximately 300 metres long, 28 metres wide with a reclaimed area behind the wharf. The berth is dredged up to a minimum of 13.5 metres alongside to allow for vessel berthing. It was constructed in the early 1990's and consists of a concrete deck slab supported on concrete/steel piles. A sloping rock face beneath the wharf was designed to resist wave induced scouring.

148. The proposed extension of the wharf will provide some 135 metres of extra workable deck over which to load and unload the vessels. It will make full use of the adjacent reclamation area, presently used for the storage of empty containers.

149. The need for this extension will exist irrespective of the requirement to undertake the lower harbour channel development work to accommodate the 6,000 TEU vessels. It is linked to a requirement to provide greater operational efficiency in a number of areas, particularly as container volumes through the port continue to grow. Ultimately the extended berth will also service the 6,000 TEU vessels.

150. Vessel arrivals at Port Chalmers increased from 227 in 1998 to 301 in 2009. However, that in itself does not reflect the significant growth that has been experienced over this time in the number of containers handled, as well as the number of passengers that need to be accommodated around the daily container terminal operations as a result of the growth in cruise ship calls as Geoff Plunket highlighted in his evidence.

151. The increasing vessel calls and growth in trade is placing operational constraints on port activity because of the current wharf configuration. It is expected that the extension of the berth will alleviate these constraints and enable the full potential of the area known as Boiler Point reclamation to be fully realised.

152. At present only 240 metres of the berth is able to be worked, for reasons set out later, resulting in significant mid-exchange manoeuvring being required. Working ships in excess of 240 metres (including the weekly call Albatross class 4100 vessels) at the extended multipurpose wharf would decrease the length of time that the ship spends in port with the result that there will be less exposure to port noise for residents.

153. The extension of the multipurpose wharf will provide Port Otago the flexibility to enable it to provide the required level of berthing commitment and guarantees to its customers. It will do so by overcoming the difficulties that currently exist as a result of the present inability to work the Albatross class 4100 container vessels (281m) efficiently on that wharf. At present it can become necessary to shift the vessel during loading/unloading when using that wharf because the cranes cannot work the whole of the vessel without the vessel having to be moved along the wharf, which interrupts and delays the operation. The need to shift the vessel reduces productivity, increases the length of time the vessel is required to stay in port and increases the cost to Port Otago, causes inconvenience and cost to the shipping operator thereby increasing the cost to the exporters, and increases the level of port noise.

154. The inability of the multipurpose wharf to fully accommodate the 4100's, and the inability for health and safety reasons to berth cruise ships on the multipurpose wharf if a container vessel is working on Container Wharf, results in Port Chalmers not being able to efficiently service a number of vessel combinations.

155. For safety reasons it is not possible to berth a cruise vessel on the multipurpose wharf if a container vessel is already berthed at the Container Wharf, although two cruise vessels can berth concurrently at the two wharves.

156. At present if a container vessel is alongside at the Container Wharf, cruise vessels must be berthed at the Beach Street forestry berth. This can result in other vessels being required to vacate the Beach Street berth in order for Port Otago to meet its obligations to cruise vessels operators. Berthing commitments can be made 2 years previously. This results in considerable inconvenience and added costs to the vessel operator, cargo owner and Port Otago. That added cost includes the cost of moving the vessel from the berth (to at times anchor at sea) and back to the wharf again after the cruise ship has departed, as well as the lost productivity by stevedores and log marshallers.

Design and Construction

157. Once approval to proceed is obtained it will take an estimated 12 to 18 months to complete the wharf extension, subject as always to the availability of contractors familiar with this type of construction in a marine environment.

158. A conceptual design has been prepared and I will outline the likely proposed construction techniques and requirements for the wharf extension and the fishing platform. The final design details and construction methodology may be altered as a result of the tendering process and the contractor’s preferred plant and methodologies. It will however be generally as I describe here.

159. The 135 metre extension will comprise the construction of a piled structure, with either a precast concrete slab and concrete topping deck, or a full depth concrete flat slab wharf deck. The piles will be driven into volcanic rock which underlies the site, the piles being placed at centres varying between 3.05 and 6.1 metres.

160. The construction will allow all port equipment such as straddle carriers, forklifts and cranes to operate on the wharf.

161. In addition to the wharf work, the existing rock protection along the face of the existing reclamation will be tidied up in conjunction with the piling and deck construction works.

162. As both the wharf extension and fishing jetty require building consents, design and construction works must comply with the Building Act. The designers and constructors of the wharf will therefore need to lodge producer statements with the council in order for building consent to be granted.

Alternatives Considered for Wharf Extension

163. The design of the wharf extension was developed such that best use can be made of the existing wharf infrastructure, and reclamation areas.

164. There are no other practical alternatives to extending the Multi-purpose wharf.

    a. Cruise vessels can not be safely berthed at the MP wharf. The large numbers of passengers and traffic associated with that activity can not be accommodated safely when the container wharf is in use for vessel loading due to conflict between visitors and large machinery.

    b. Large container vessels can not work at Beach St due to the lack of water depth alongside at the berth as well as no cranes being present on the wharf. The other reason is the significantly increased distance to take cargo from Beach St around to the main container stacking areas.

    c. Although technically logs could be worked at the Container and Multi-purpose wharves, it is not practical due to the long distance from the log storage area.

    d. The Container Wharf can not be practically extended to the south by more than approximately 15m as a longer extension would impact on the incoming rail line to the port area as well making access around to Beach St more difficult and congested. This relatively small increase in length of the Container Wharf, would also result in little operational benefit to berthing and loading of the larger vessels.

165. On this basis the only practical option is to extend the Multipurpose wharf.

Fishing Jetty

166. In keeping with an undertaking given by Port Otago in 2007 as part of its commitment to the community and in accordance with the "Port Environment Plan", the Multipurpose wharf extension will include the additional construction of a 30 metre long jetty at its north eastern extremity.

167. The sole purpose for the construction of this jetty is to enable members of the public to gain access to the coastal marine area, and for the purpose of recreational fishing.

168. The jetty will be separated both vertically and horizontally from the Multipurpose wharf and a safety / security fence will be installed at the boundary between the jetty and the wharf operating area to ensure public safety from port operations.

169. Access for members of the public will be gained via a landscaped public walkway that was created along with the Boiler Point reclamation. Vehicles are excluded from the structure and the walkways.

170. The proposed fishing platform sub structure will also be constructed on either concrete or steel piles and with concrete beams or caps. The loads on this jetty will be significantly less than the wharf extension, however the construction techniques are likely to be similar to that of the Multipurpose Wharf extension.

171. The wharf deck and handrails will be constructed of appropriately sourced hardwood timbers, recycled where possible.

172. It is important from time to time for operational and safety reasons for Port Otago to be able to restrict public access. Port Otago is entitled to do this pursuant to its existing coastal permit that includes the fishing jetty area. There might occasionally be the need to exclude the public from the fishing jetty and any coastal permit permitting occupation of the jetty area needs to be subject to Port Otago's rights under its existing coastal permit.

Rock Stabilisation of Wharves and Berths

173. I will describe in this section the increase of the depth of the areas underneath and adjacent to the Container Wharf and the Multipurpose Wharf (including the proposed extension to the Multipurpose Wharf) and outline the necessary rock stabilisation works required to be undertaken in order to preserve the stability of the embankment. These are shown on Figure 14.

174. There are three key elements of work to be undertaken
   a. Dredging the buttress areas to a depth of 18 metres and removing silt and clay.
   b. Placement of two metres of rock to provide toe support to the sloping rock wall revetment that exists beneath the wharf structures.
   c. The placing of the rock revetment on the slope as an anti scour protection and slope stabilisation.

175. The rock is required because the deepening of the area underneath and adjacent to the Container and Multipurpose Wharfs risks undercutting the existing piled wharf structure. The front and rear piles of the wharf support the considerable loads generated by the gantry cranes during the vessel loading and unloading, with the remaining central piles of the wharf supporting the main wharf deck which carries straddle carriers and large forklifts.

176. The reclaimed area behind the wharf which forms the operational apron is protected from wave effects and is supported by a sloping rock revetment located beneath the wharfs to a depth of approximately 5.0 metres below chart datum (CD). As a result of the deepening to 18.0 metres below CD, the support at the base of this revetment will effectively be removed. This has the potential, particularly as a result of earthquake excitation, to result in a rotational failure within the reclaim.

177. To reduce the risk of this rotational failure, the sloping rock revetment is to be extended down to the newly dredged level and any silt or clay material beneath the wharf that is not currently protected by rock will be covered with a protective layer of rock. It is intended that this rock will be sourced from rock excavation at Rocky Point and/or Acheron Head, but rock may

also be used from an approved land based quarry (such as Palmers Quarry). This would occur if the rock removed from the channel is unsuitable.

178. Further support is to be provided at the base of the revetment slope by forming a buttress or mattress of rock at the invert of the berth pocket. This buttress is a minimum of 2 metres thick and 8 metres wide for the full 600 metres of both wharfs. The lower excavated level of this buttress has been designed at 18 metres below CD to allow for the 2 metres of placed rock plus a 1 metre siltation allowance, giving a final berth depth of 15.0m.

179. The rock would then be placed on the sloping revetment.

180. Due to having to undertake this work around the shipping operations at the wharves, there will be considerable downtime on this particular job. In addition, much of the work under the wharf will be constrained to some extent by the tides, hence opportunities may only exist to work over the bottom of the tides.

181. It is possible that with the construction constraints discussed above, and the technical difficulties, that this work may take a number of years to complete.

182. The design assessment work has been undertaken by Hadley and Robinson Ltd, Dunedin based Consulting Engineers, and the final design and construction methodology will be reviewed once a contractor has been selected and the contractors preferred methods can be assessed in detail.

INVESTIGATIVE APPROACH TAKEN

183. I would like to now provide an overview as to the approach that was taken and the process that was followed to execute the investigations that were carried out.

Preliminary Assessment

184. At the inception of the project a preliminary environmental evaluation was carried out, by leading experts in key fields. The evaluation comprised the following.

a. Collating and summarising existing information on the receiving environment for the project.

b. Identifying potential key issues/effects of the project on that environment.

c. Identifying the further studies required to assess the project in the context of the RMA.

185. A significant body of information existed from a variety of sources from work in support of previous harbour works (including dredging) and also for purely scientific and academic purposes by the University of Otago and other similar or related institutions.

186. The 4 preliminary reports provided a good understanding of the information available, key values of the environment in which the project is being undertaken, as well as identifying gaps in knowledge and recommending further works required.

187. Stakeholder consultation which I will describe in more detail soon had commenced at that point and played an important role in identifying the community and stakeholder issues, as well as potential issues/effects of the project on the environment that needed to be addressed as well as further potential information gaps.

188. These information gaps were then developed into a broad ranging and detailed investigation that was undertaken so that the full effects of the project could be comprehensively assessed in the context of the RMA.

Detailed Project Assessment

189. The detailed project assessment was categorised into 4 key areas.

a. Biological / Ecological Environment

b. Physical Environment

c. Dredging and Design

d. General and Related Studies

190. The physical sciences work involved a lot of modelling work with collection of field data and information to be used in verifying the modelling assumptions. The ecological sciences portions of work required a lot of fieldwork in order to be able to more accurately describe the environments that are present.

191. Much of this work advanced in parallel, whereas there were other aspects of the work that further informed us, that there was still gaps in information that required further work.

192. All 22 reports were prepared over a 2 year period across the 4 subject areas. This provided the necessary information to be able to make a detailed and comprehensive assessment of the environmental effects of the project.

193. Many of the authors of the scientific reports will present evidence at this hearing.

Recent Works

194. Since the application was lodged and submissions closed Port Otago has completed more research that is useful in describing the effects of the project. This includes;

    a. Completed peer reviews of the hydro modelling.
    b. Collected additional ocean current data at A0.
    c. Undertook additional detailed biological monitoring at A0.
    d. Undertook further contamination testing.
    e. Undertook field surveys for a rare species of brachiopod.

195. This information will be included in the various evidence from experts involved.

LANDSIDE MATTERS – GENERAL DISCUSSION

196. During the same period of time the investigations in relation to Next Generation were being undertaken, Port Otago did review a number of indirect matters relating to the need for general increases in efficiency and capacity associated with the landside operation of the port for the future. Included in this work were assessments of the ports container terminal capacity, rail connections, as well as road capacity. The responsibility and jurisdictions for both road and rail lie with NZTA and Ontrack respectively

197. A number of matters have been raised by submitters in relation to these topics. They are not directly related to the project outlined, however a brief

overview of what Port Otago has done is as follows to provide some context to the project.

Terminal Capacity

198. In order to identify methods and ways of optimising port operational efficiencies for any future growth (regardless of Next Generation), Port Otago has reviewed its container terminal capacity.

199. In 2008 Port Otago commissioned TBA, a specialist port simulation consulting company from the Netherlands to undertake a detailed evaluation of the container terminal operation.

200. A core part of the study was to consider the utilisation of the existing container terminal wharves and land area, and to identify what options were available to improve the efficiency and capacity of those areas, and determine the steps required to increase container throughput.

201. An important element of this work was to consider the upgrading of equipment and technology solutions.

202. TBA identified a number of solutions which if all were implemented would provide the ability to increase the container terminal capacity within the existing container terminal footprint to at least 550,000 TEU per annum whilst continuing to maintain a straddle carrier operation.

203. These solutions included altering the mix of empty and full containers on site, improving container dwell times, moving to 4 high straddle carriers and the removal of some of the cargo storage and packing facilities currently located in the terminal. A number of these steps are currently underway.

204. Further capacity is available beyond these levels described, but based on current growth projects would not likely be required for another 15-20 years.

Rail Capacity

205. Rail continues to be an important means of connecting the port to the cargo catchment for distributing both full and empty containers and for the

receipt of high volume breakbulk products. This will become increasingly important as volumes grow and alternative or offsite empty container storage becomes a necessity.

206. While it may be possible to develop additional terminals and hence capacity at the Dunedin and Port Chalmers ends of the rail corridor, the increased capacity may not be as simple to achieve along the corridor itself.

207. Advice was sought from the rail operator “Kiwi Rail” and this confirmed however that there are a number of effective ways that they believe the currently underutilised rail capacity can be further enhanced to accommodate additional growth in rail traffic.

208. Current developments are underway working with Kiwirail and Fonterra to increase the volume of product from the Fonterra Mosgiel stores coming to Port Chalmers.. This has included additional rolling stock and provision of labour and equipment at each terminal end. In addition Kiwirail finished upgrading the reliability and capacity of the rail corridor in 2010, completing the replacement of 2 speed restricted bridges where the rail crosses the outlets to the numerous lagoons directly adjacent to SH88.

209. Further improvements such as these are and will be available in the future to increase capacity of rail between Port Chalmers and Dunedin.

Road Capacity

210. Port Otago commissioned Traffic Design Group to prepare a report on the capacity of State Highway 88 connecting Dunedin with its North / South linkages to State Highway 1 and Port Chalmers.

211. The review concluded with the following - *“The existing transport environment has shown that additional heavy vehicle transport could be accommodated on SH88 without affecting the capacity or safety of the network for other motorised road users.”*

NAVIGATION

212. All vessel activity associated with the dredging and disposal activities will be managed by Port Otago and the Harbourmaster, and it is not expected that any changes to the current navigational arrangements and procedures will be required. Some shifting of existing navigation aids will be required as a result of the wider channel however, the navigation environment will be similar or in fact improved.

213. The harbour channel to port Chalmers will be deeper and wider and therefore a overall safer navigation environment for recreational, other commercial as well as port related traffic in the harbour.

214. As other witnesses Dr Rob Bell & Dr Martin Single will outline, the deeper and wider channel will result in very small changes to the hydrodynamics of the harbour, however they are not significant enough to have an effect on vessel navigation. Similarly the effects of sedimentation in other parts of the harbour away from the main shipping channel are discussed by other experts.

NOISE OVERVIEW

215. I will now provide an overview of the noise management regime which is in place for the port operation and the communities adjacent to the port.

216. The Dunedin City District Plan requires Port Otago to implement a Port Noise Management Plan as well as a Port Noise Mitigation plan. These two plans provide more detail of how the requirements of the District Plan are to be implemented. This regime has been in place since 2004, following an extensive council hearing and environment court process.

217. The Port Noise Liaison Committee is a pivotal group being made up of representatives from surrounding residential areas, recreational groups, the business community, the local authorities, exporters and Port Otago. The Committee has a role in overseeing the implementation of the plans.

218. The management plans require regular assessment and monitoring of the noise emitted from the port, and these noise levels are used to determine the noise levels that residential properties are exposed to as a result of the operation of the port. A specific internal noise level of 40dBA is set and

acoustic treatment carried out by Port Otago is to reduce the internal noise to these levels.

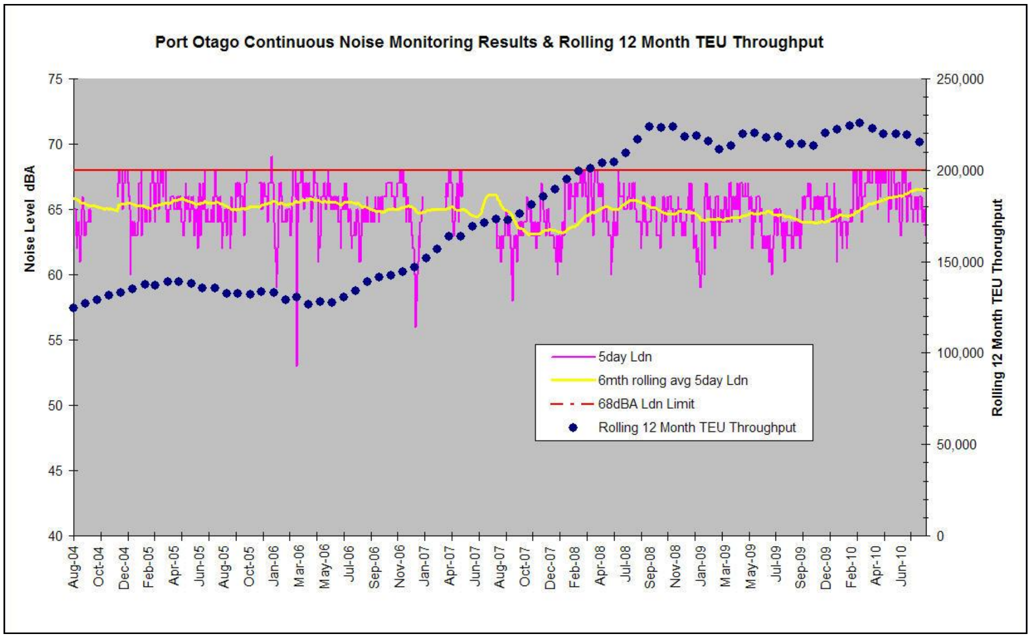
219. In addition to acoustic treatment provisions, for the highest exposure properties there are also provisions requiring compulsory purchase of a property by Port Otago, at agreed market value if an owner wishes to enforce that option.

220. Since commencing the program in 2004 progress on the acoustic treatment work in the Port Chalmers area has been steady with acoustic treatment works having been completed on 16 properties at an approximate cost of approximately $1,000,000.

221. Five properties have been purchased at a cost of approximately $780,000.

222. In addition, purchasing of hush-technology equipment and costs associated with noise monitoring have totalled more than $150,000.

223. Port Otago undertakes monitoring of noise from the port operation and the following graph highlights the long term trend in continuously measured noise at Port Chalmers as well as the container volume throughput. The success of the noise mitigation measures are reflected in the fact that although the container throughput at Port Chalmers has risen from approximately 125,000 TEU per annum in the 2004 year to the current level of approximately 220,000 TEU per annum there has been no appreciable change in the monitored 5 day Ldn noise measurement over that period.



224. Port Otago is committed to continuing to implement the requirements of the District Plan as well as the Port Noise Management Plan and the Port Noise Mitigation Plan.

225. Mr Keith Ballagh specifically discusses in his evidence the noise environment and effects. As well as covering operational matters, Mr Ballagh outlines a detailed regime of measurement and monitoring of dredging activities as well as limits within which the dredging operations are to be managed. These have been adopted within the conditions of consent and the environmental management plan.

OTHER MATTERS

Visual

226. The operation of the dredging equipment will be in keeping with what is expected on the harbour, with shipping traffic coming and going as well as the activity of ongoing historical maintenance and development dredging, in many respects being the status quo. The duration of activity as a result of the works will be greater than has been experienced in recent history, however will not be permanent.

227. The visual context of the container terminal from Port Chalmers, and its two wharves is dominated by the combination of the cranes and container ships (unrestricted height), storage sheds (not exceeding 15 metres high), and stacked containers (5 high on a short term basis at Boiler Point). This is the permitted environment and is unaffected by the proposal to develop an additional wharf.

228. When vessels or cranes are working at the extended multi-purpose wharf, they would be in the view of some residences view of Carey's Bay, along Aramoana Rd and also residences along Harbour Tce. At some times depending on the shipping and general port activity, it will be necessary to park the cranes on the extended Multi-purpose wharf.

229. Many submissions raised the potential visual effects, suggesting restrictions be imposed on the development.

230. It is essential that the port is able to operate in an integrated manner over whole of the site without restrictions to operations within certain or specific areas. If the port is unable to efficiently and effectively use the whole of the site our ability to provide excellent service would potentially be compromised.

231. Hence any suggestion to restrict the use of the extended multi-purpose wharf to reduce a potential visual effect would severely restrict the ability to use the wharf itself and have knock-on consequences reducing the efficiency and viability of the port operations. Such restrictions would undermine the very purpose of having the extended wharf.

Lighting

232. Lighting is a necessary part of providing a safe working operation whilst vessels, cranes and port machinery are working. The zoning of the area being Port 1 zone in the District Plan is consistent with this. Lighting is used throughout the port areas whilst both vessel and yard operations are being undertaken, including the area of the Boiler Point at the northern end of the container terminal.

233. In regards to lighting associated with vessels, cranes and machinery working, it is similar to what I discussed in visual in that any potential effect is only present whilst the activity is being undertaken.

234. Suggestions to restrict operating hours such as a daylight only restriction for the new wharf would severely restrict operations and make the operation and hence construction of the wharf unviable.

235. In respect of and dredging disposal operations, a specific section within the environmental management plan outlines both general and specific lighting management measures.

Odour

236. At times, the harbour in certain places and times of the year does produce odour that some people find offensive. There are significant areas of intertidal parts of the harbour that have natural communities (eg algae, sea-weed, sea-lettuce) that particularly at low tide can produce these offensive odours, as well as being close to where the public frequent or reside.

237. One such example I have had personally relayed to me is the small embayments between the State Highway 88 roadway and the railway embankment between Ravensbourne and St Leonards.

238. These natural communities and potential for annoyance will persist regardless of the dredging and disposal activity.

239. The geotechnical investigations and the contamination sampling did not show any materials with significant organic material within the sediments that could potentially create odour as a result of the dredging activity.

240. I do not believe there is any significant odour effect directly related to the activity of dredging.

Te Rauone Beach

241. The historical erosion and shoreline changes at Te Rauone Beach, have been well documented and discussed over the past 50 years. Port Otago

became involved in 2004 by way of undertaking an internal study on the potential causes.

242. What I describe here in relation to Te Rauone Beach is not part of the current applications and assessment of effects for Next Generation. The beach re-nourishment and rock breakwater works are a separate project and independent of the assessment and outcomes of Next Generation.

243. The historical erosion and shoreline changes at Te Rauone Beach, have been well documented and discussed over the past 50 years. Port Otago became involved in 2004 by way of undertaking an internal study on the potential causes.

244. Dr Martin Single was commissioned by Port Otago to undertake an assessment of the history, the current situation, as well identifying potential solutions or management options. The preferred option outlined in a 2007 report proposed beach renourishment and a rock breakwater structure as the most appropriate solutions.

245. Strong support from the local community existed and Port Otago suggested that a Coast Care Committee or group be formed to bring representatives from the community together around the project. This was done and has worked as an effective forum in progressing the project.

246. With this strong input and support from the community, Port Otago co-ordinated the preparation of the design work as well as an assessment of effects in relation to the nourishment and breakwater.

247. Design works have been completed and consent documentation is nearing completion with lodgement of a consent application is expected in the near future.

PROJECT CONSULTATION, REPORTING & MEDIA

Past

248. The consultation process for the project was initiated early in August 2007 and has been wide-ranging with many groups and many forums throughout the investigation phases of the project. Newspapers and the Port Otago website were both used during the project.

249. The project consultative group provided a forum in which information could be shared, views sought and progress on work underway could be updated. The group was independently chaired, and included a broad range of individuals and groups who were interested and potentially affected by the project.

250. This process allowed Port Otago to receive feedback from that consultation to be incorporated into the project and hence the assessment of effects. In all the group met 12 times over a period of two and a half years from August 2007.

251. Port Otago and our advisors met with many individuals and groups separately during the course of the investigations in order that specific feedback and input could be sought. These meetings provided the opportunity to discuss specific areas of concern and as appropriate to enable Port Otago to incorporate them into the research work and assessment of effects with these.

252. Some groups have chosen to actively participate in consultation and we have spent considerable time and effort as a team, being available with our expert advisors to spend time with these groups, listening to their concerns, input and feedback.

253. A draft AEE was publically circulated, and feedback was sought on that prior to lodgement of the consent.

254. As the investigative work proceeded, many of the completed reports were uploaded onto the Port Otago website so that they were easily accessible. Following the circulation of the draft AEE, all reports were available on the website and we made many copies onto CD of all the reports to give to some people who requested them. Upon request from some individuals we copied a number of the reports in hard copy.

255. Since the lodgement of consent and closing of submissions Port Otago have continued to meet individually with stakeholders. We have listened to their concerns and where possible have tried to incorporate that within the conditions of consent and environmental management plan which I will discuss in more detail soon.

Future

256. The conditions of consent and the environmental management plan both contain significant requirements for ongoing consultation, reporting of information and notification of works.

257. It is intended to continue to use the Port Otago website as a medium to make relevant information such as work schedules and monitoring and reporting information available. In addition requirements to publish work schedules in the printed media is also accepted.

258. The project consultative group as a forum for the wider public to participate in will continue to function.

CULTURAL MATTERS

259. Consultation with tangata whenua interests have been ongoing throughout the investigations stage of the project. The proposal and how it will be undertaken as well as the ongoing relationship between tangagta whenua and Port Otago through the undertaking of works will be enhanced by the process that we have been through.

260. Separate meetings with individual groups were held to specifically discuss those groups' interests, and representatives from interested groups also participated in the Project Consultative Group.

261. Early in the consultation phase of the project members from both Te Rūnanga o Ōtākou and Kāti Huirapa Rūnanga ki Puketeraki requested that a Cultural Impact Assessment (CIA) be prepared. This was to assist in a better understanding of the proposal and its likely effects, as well as being able to put the project in the context of the connection that the tanagata whenua have with the habour, its surrounds and the natural environments.

262. Port Otago commissioned Kai Tahu Ki Otago (KTKO) to prepare the CIA. The preparation of the CIA was a collaborative one, and involved setting up of a working party (the Manawhenua Working Group) of 6 represented parties of Kai Tahu Whanui. This group, KTKO and Port Otago worked together throughout the preparation phase of the CIA.

263. The process of preparing the CIA included identification and scoping of issues following meetings and interviews with working party members as well as working meetings with Port Otago representatives and professional advisors. KTKO and the working party were provided project information from Port Otago gradually as well as on request further supplementary information of specific interest. Both technical and general peer reviews of the CIA document were undertaken.

264. The CIA contained 15 separate recommendations covering general, hydrodynamic, physical coastal environment, sedimentation as well as ecology aspects of the project. The additional information requested in the recommendations has been provided by Port Otago. The remainder of the recommendations are all included in various forms within the Conditions of Consent and Environmental Management Plan.

265. The recommendation to establish a Manawhenua Consultative Group (MCG) is welcomed by Port Otago. The MCG will provide the forum in which ongoing consultation, involvement in the monitoring and reporting associated with the project can be undertaken.

266. Port Otago have proposed a detailed outline of the formation and role of the MCG within the Environmental Management Plan. Although the draft conditions of consent contained in the Officers Report do not include this level of detail, Port Otago would strongly support the inclusion of the same level of detail currently within the draft EMP to be adopted within the final conditions of consent.

CONDITIONS OF CONSENT & ENVIRONMENTAL MANAGEMENT PLAN

267. The dredging and disposal of materials generated through the Incremental as well as the Major Capital dredging programmes, the extension of the wharf and the fishing platform and the placement of rock will result in environmental effects of varying degrees.

268. The proposed consent conditions which have been formulated are designed to monitor the key environmental effects and outline steps to manage and mitigate effects that may arise from the intended works.

269. The scale of the effects will vary and will be differentiated by the two options available to undertake the capital dredging. In general terms Incremental dredging will generate lesser effects than major capital dredging, however irrespective of the level of effects Port Otago intends to actively manage the project thereby minimising any potential adverse environmental effects.

Environmental Management Plan

270. Port Otago has prepared a draft Environmental Management Plan (EMP).

271. Updated EMPs are required to be submitted to the consent Authority prior to the commencement of any works under the proposed consents.

272. More detail will be added to the EMP once Contractors are selected to undertake specific portions of the works, with the Contractors being involved with developing and implementing specific methodologies and programmes for their portion of work.

273. Even after this stage, changes to the work programme during the Project will mean that the EMP will require updating. The EMP document should be thought of as a 'live document' that will be reviewed, updated and referred to throughout the Project.

274. The stated objectives of the EMP are to guide environmental management for the duration of consented activities, and to establish measures to avoid, remedy or mitigate any adverse environmental effects associated with consented activities. The purpose of the EMP includes to provide :

a. a list of key personnel and points of contact during the project;
b. Requirements for consultation, including specifically the Manawhenua Consultative Group and the Project Consultative Group.
c. a description of how stakeholders will be kept informed and involved during the project and how complaints will be managed;
d. a description of the staging plan for the project, identifying the works and proposed duration of each stage;
e. a description of the dredging and disposal methodology;
f. Identification of reporting requirements as a result of any monitoring undertaken.

g. a description of what actions will be taken to adaptively manage the actual or potential effects of consented activities (including relating to noise, contamination, water quality, bathymetry, aquatic communities, and use of explosives) to satisfy consent conditions.

275. The monitoring and adaptive management sections of EMP in relation to specific aspects or topics are as currently as follows:

a. Water Quality
b. Verification of Dredging Plant Operations and Hydrodynamic Model Verification
c. Bathymetric Surveys
d. Tide and Current Measurement
e. Dredge Material Characteristics
f. Birdlife
g. Aquatic Communities
h. Noise
i. Use of Explosives
j. Mammals and Cetaceans

Adaptive Management Approach

276. Port Otago will implement an adaptive management approach, the basis of which will be the EMP for the various activities. The adaptive management approach involves monitoring the effects of the project on key resources and implementing a management strategy, in response to the monitored effects that avoids, remedies or mitigates adverse effects.

277. There will be various types and scales of mitigation responses that can be implemented to address potential adverse effects. The exact type and mix of mitigation options to be utilised will be adapted to suit the circumstances that exist for each site specific issue.

278. Port Otago will adaptively manage the monitoring and mitigation that will be implemented as part of the Project. The EMP will identify how environmental 'response levels' will be defined and monitored, to ensure any adverse effects are identified, and will establish the investigations to be carried out and mitigation measures to be implemented to minimise any adverse effects,

279. An example of these mitigation measures is for turbidity if response level 2 is exceeded where the management action steps identified in the EMP are:

a. Relocation of the dredge

b. Reducing dredging frequency

c. Operate dredge in non-overflow mode.

These are extreme responses and underlie the necessity of Port Otago managing the dredging to reduce the turbidity level if it wants to be able to continue dredging in an area that will affect the relevant turbidity levels in that area.

280. The environmental limits contained in the tables and monitoring programmes have been developed with a team of independent experts, and are based on industry best practice. The approach taken in the EMP is designed to identify and monitor the effects from the dredging and disposal operations when monitoring against the environmental limits.

281. A number of submitters have suggested specific conditions in relation to restricting dredging operations, such as only on the outgoing tide, or when the wind is blowing from certain directions. Such conditions are rigid and not effects based, and could significantly affect the cost and duration of the project, without necessarily any environmental benefit. The concerns that underlie these suggestions are better met by the adaptive management approach which identifies and acts on matters of concern.

282. The actual management actions that are implemented when a response level is met could include some or all of the actions which have been proposed by submitters, but in the appropriate context.

283. The EMP has a stepped or tiered “response levels” approach which provides an early warning system of levels approaching an environmental limit. Once the first response level is reached active management is required to commence. This is common in the marine environment and has been used elsewhere, in particular for aquaculture.

284. As an example, if whilst dredging in Harington Bend area, the turbidity monitor at Aramoana or Omate Beach was to exceed the response of 24 NTU (response level 2) then the EMP would require Port Otago to manage

the dredging process to reduce turbidity. If Port Otago does not choose to suspend dredging or relocate the dredge away from that area then it has to reduce turbidity in some other manner. The monitoring ensures that the active management has a successful outcome at a level below the specified environmental limit of 35 NTU.

SUMMARY

285. This project is a very important project for the port, the city and the wider region. It is essential to undertake the project if we are to provide and operate an efficient and competitive port in the future.

286. In arriving at where we are today, Port Otago has undertaken:

a. a comprehensive series of technical studies

b. across a wide array of disciplines

c. over a considerable length of time.

287. A broad range of community engagement and stakeholder consultation was included in the process from the outset. Input from stakeholders, both individually and through the Consultative Group has been incorporated throughout the development of the project and Port Otago has committed to continue this through the execution stages of the project.

288. Port Otago also wishes to continue active engagement with tangata whenua, and strongly supports the inclusion of this commitment within the conditions of consent.

289. A large number of specialist consultants have been engaged to assess the environmental aspects of the project. I am satisfied that the project has been developed in accordance with best international practice and it will be implemented in a way that provides for the long term sustainability of the environment, the community and the port.

290. The outcomes of the technical assessments are reinforced by a comprehensive suite of Conditions of Consent and Environmental Management Plan that we are committed to implementing.

Lincoln Murray Coe

Port Otago Ltd – Project Next Generation
Evidence of Lincoln Coe
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All figures listed above originate from original A3 drawings within the AEE

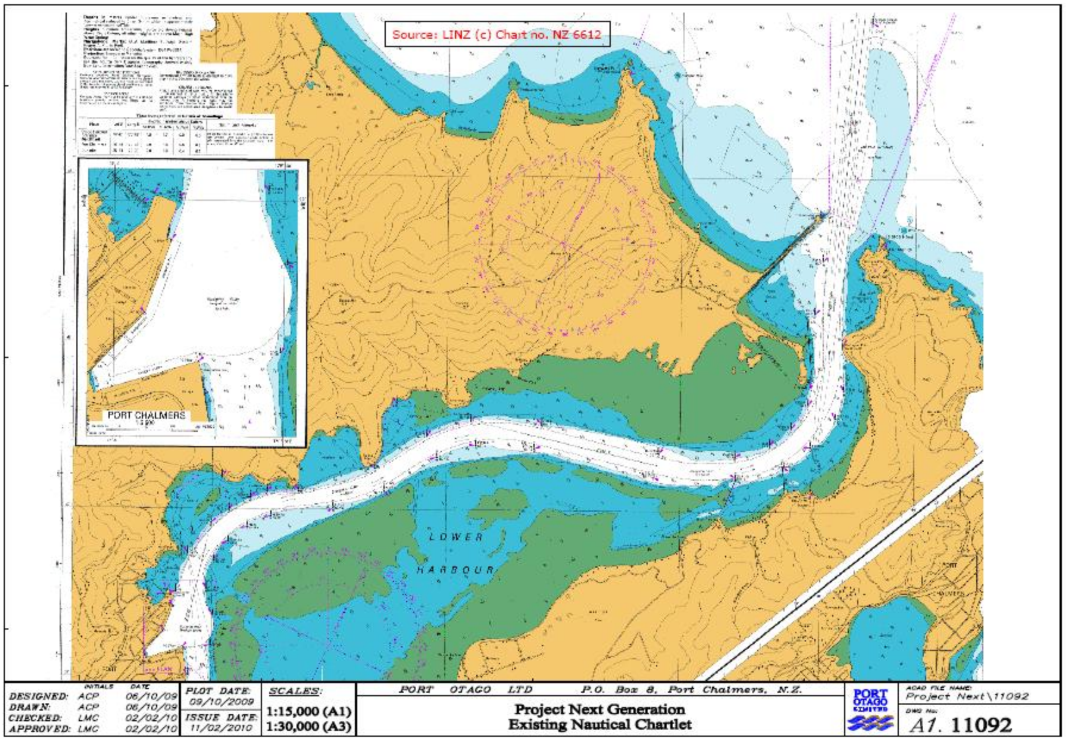


Figure 1 Existing Nautical Chartlet

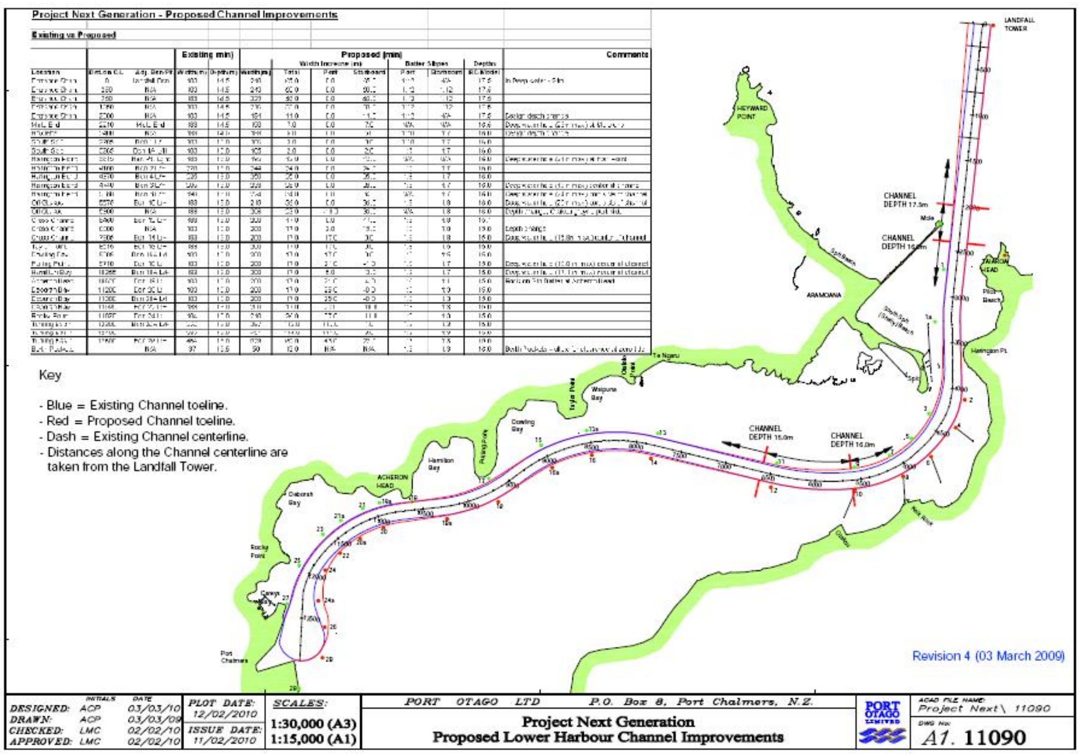


Figure 2 Proposed Lower Harbour Channel Improvements

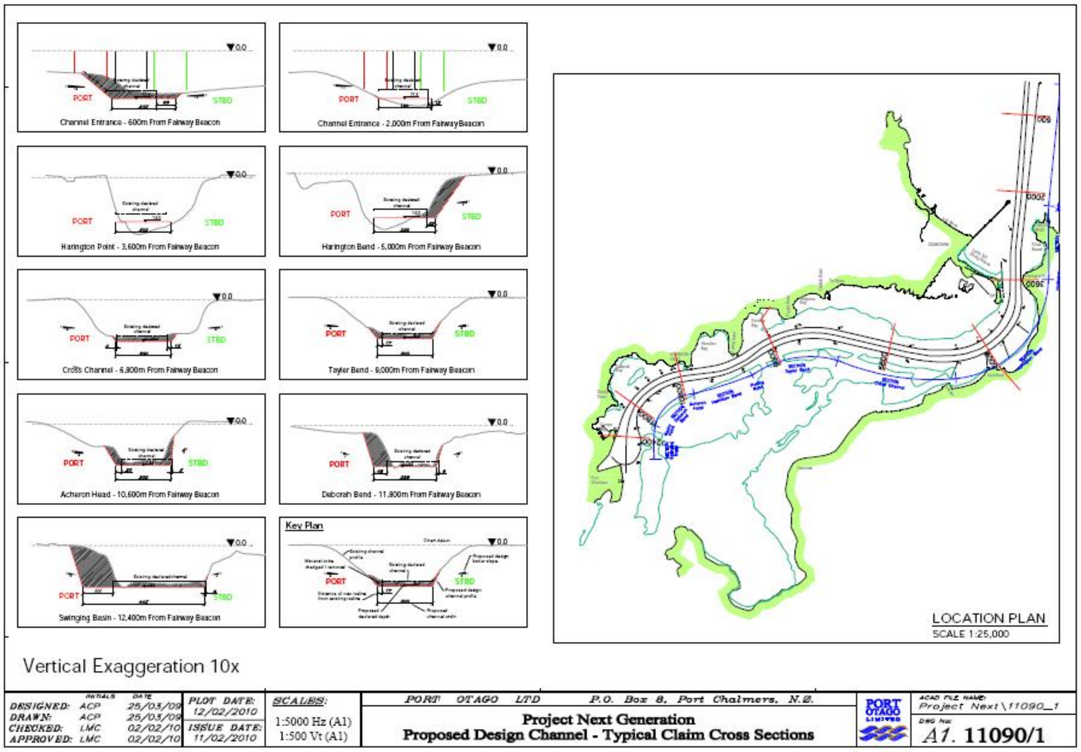


Figure 3 Proposed Design Channel – Typical Claim Cross Sections

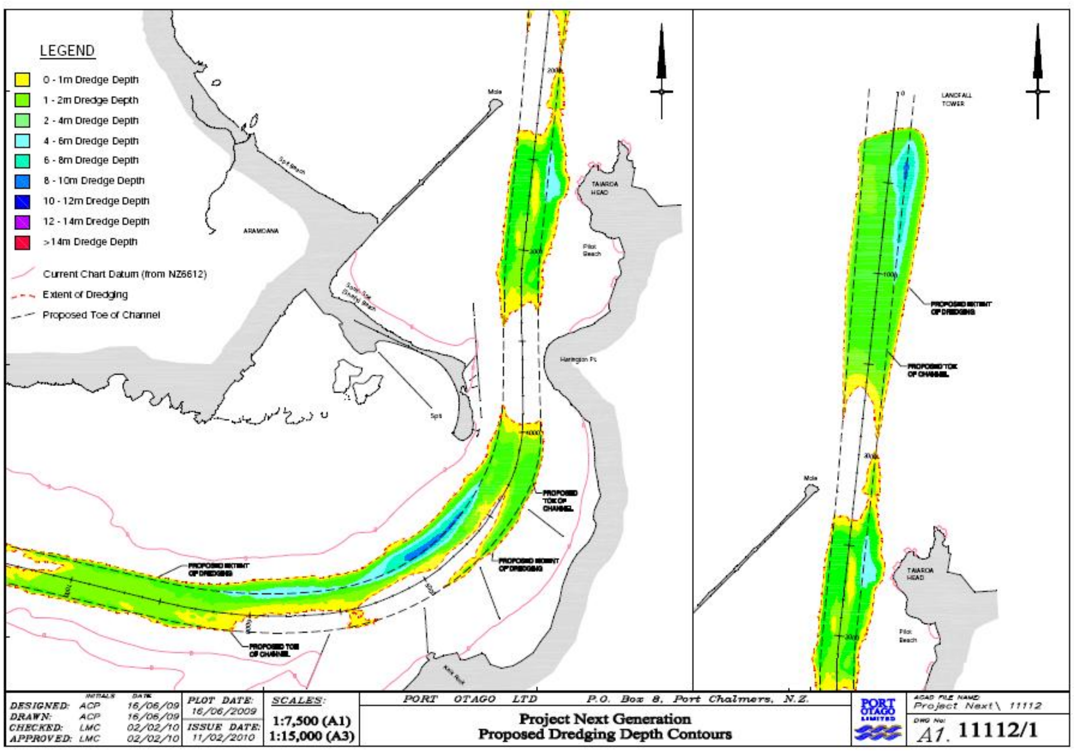


Figure 4 Proposed Dredging Depth Contours (Sheet 1 of 2)

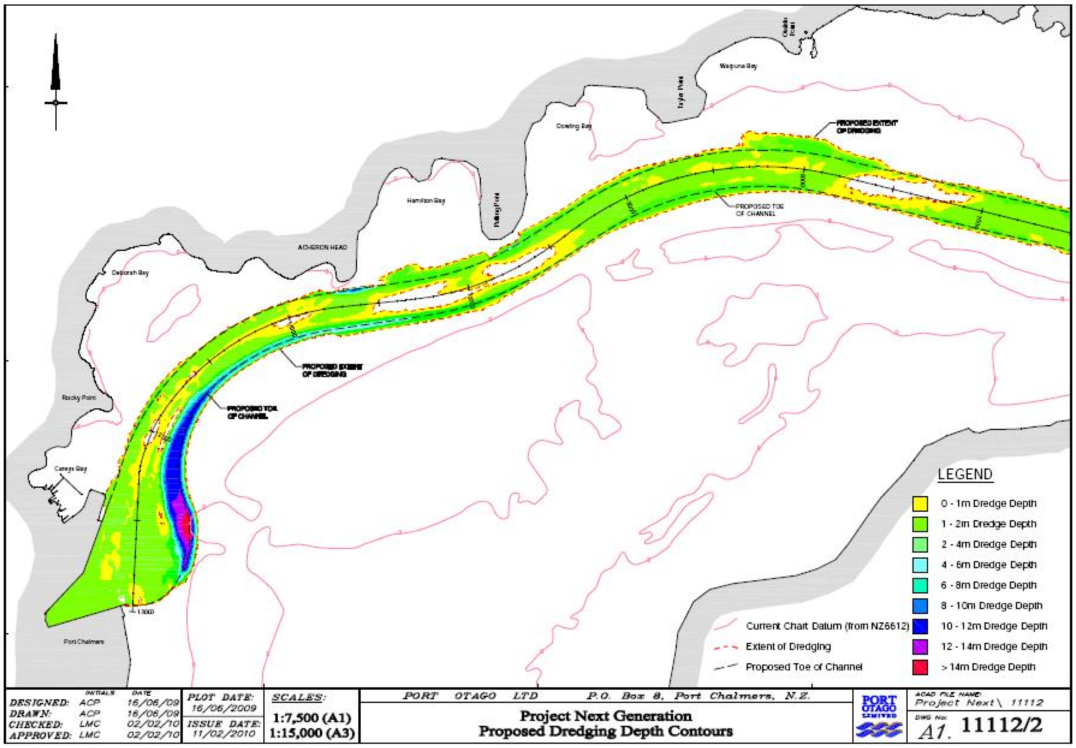


Figure 5 Proposed Dredging Depth Contours (Sheet 2 of 2)

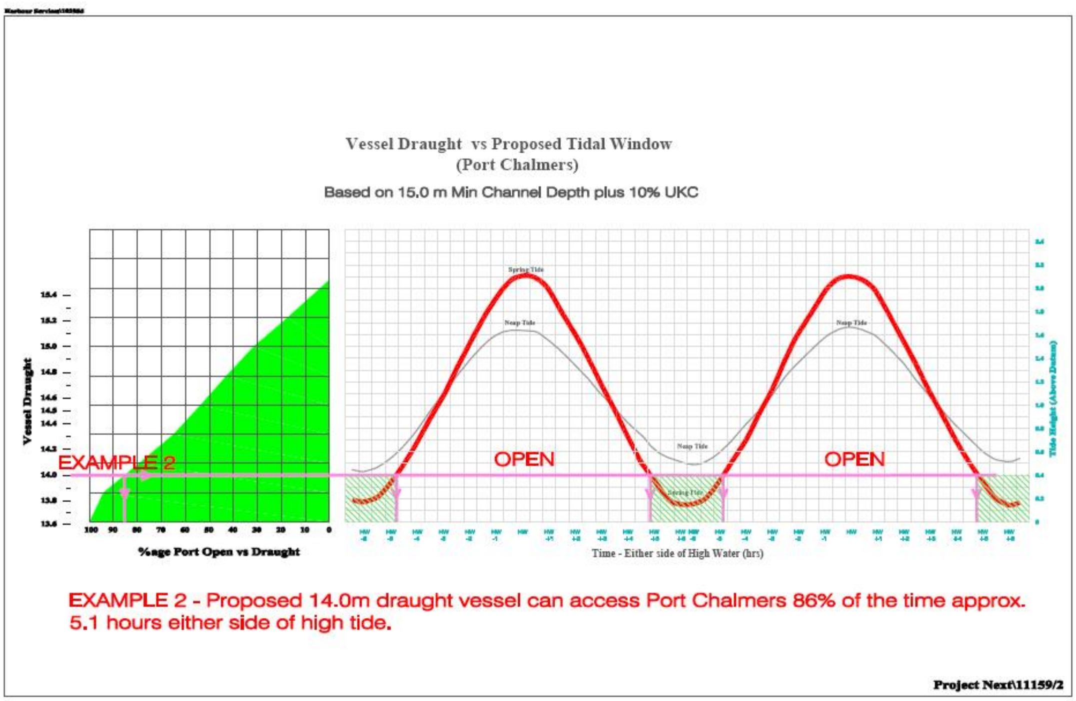


Figure 6 Vessel Draught (14.0m in a 15m channel)

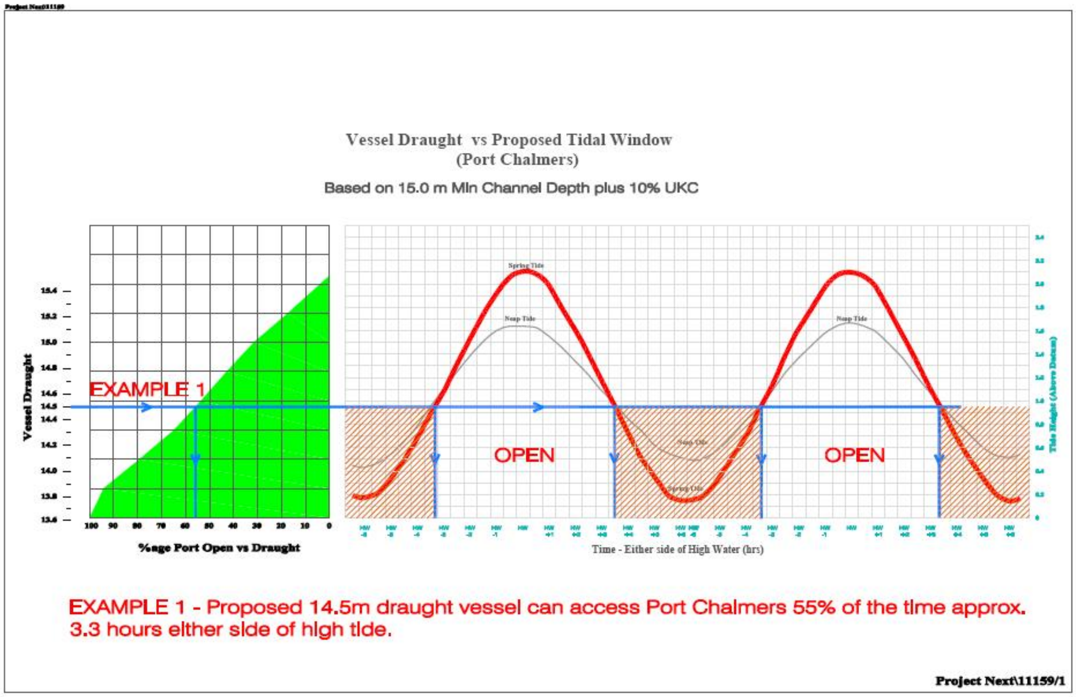


Figure 7 Vessel Draught (14.5m in a 15m channel)

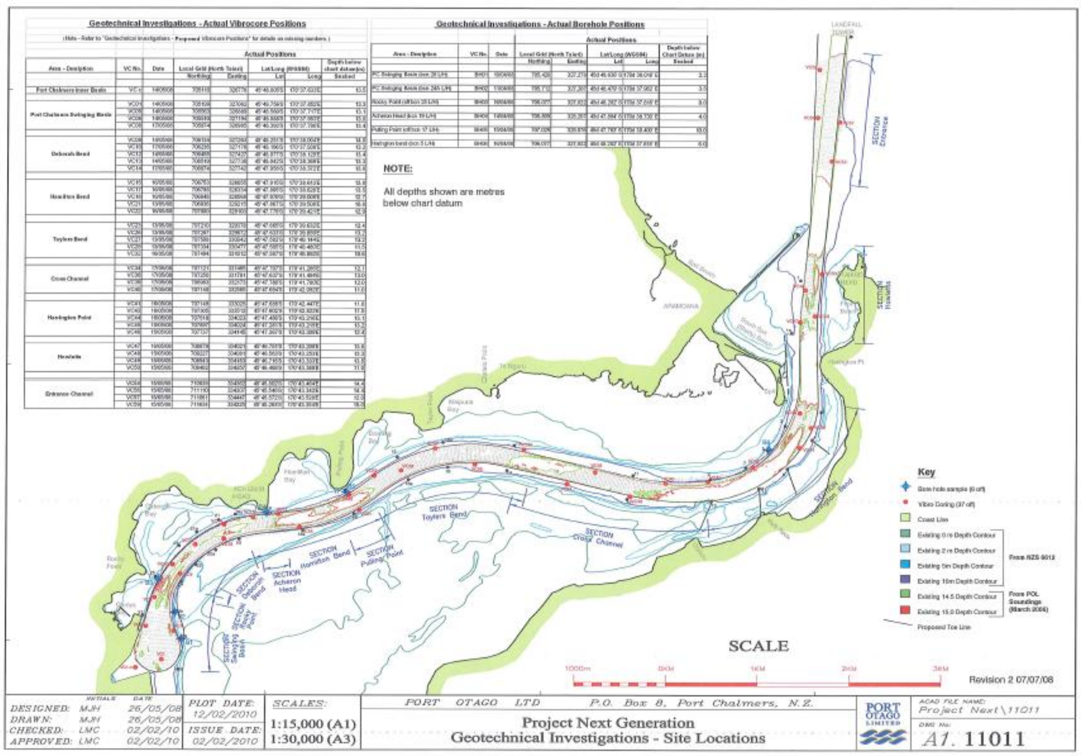
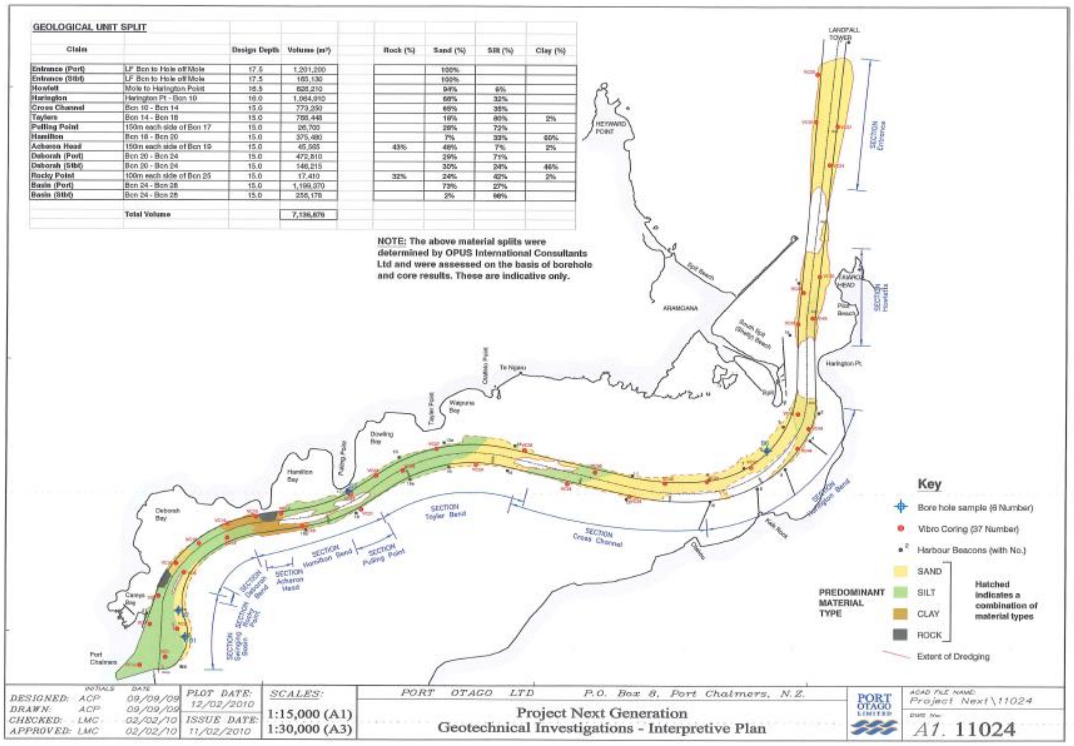


Figure 8 Geotechnical Investigations – Site Locations



GEOLOGICAL UNIT SPLIT							
Claim		Design Depth	Volume (m³)	Rock (%)	Sand (%)	Silt (%)	Clay (%)
Entrance (Port)	LF Bcn to Hole off Mole	17.5	1,201,200		100%		
Entrance (Stbd)	LF Bcn to Hole off Mole	17.5	165,130		100%		
Howlett	Mole to Harington Point	16.5	626,210		94%	6%	
Harington	Harington Pt - Bcn 10	16.0	1,064,910		68%	32%	
Cross Channel	Bcn 10 - Bcn 14	15.0	773,290		65%	35%	
Taylers	Bcn 14 - Bcn 18	15.0	768,448		18%	80%	2%
Pulling Point	150m each side of Bcn 17	15.0	26,700		28%	72%	
Hamilton	Bcn 18 - Bcn 20	15.0	375,480		7%	33%	60%
Acheron Head	150m each side of Bcn 19	15.0	45,565	43%	48%	7%	2%
Deborah (Port)	Bcn 20 - Bcn 24	15.0	472,810		29%	71%	
Deborah (Stbd)	Bcn 20 - Bcn 24	15.0	146,215		30%	24%	46%
Rocky Point	100m each side of Bcn 25	15.0	17,410	32%	24%	42%	2%
Basin (Port)	Bcn 24 - Bcn 28	15.0	1,199,370		73%	27%	
Basin (Stbd)	Bcn 24 - Bcn 28	15.0	256,178		2%	98%	
	Total Volume		7,136,876				

Figure 9 Geotechnical Investigations – Interpretive Plan

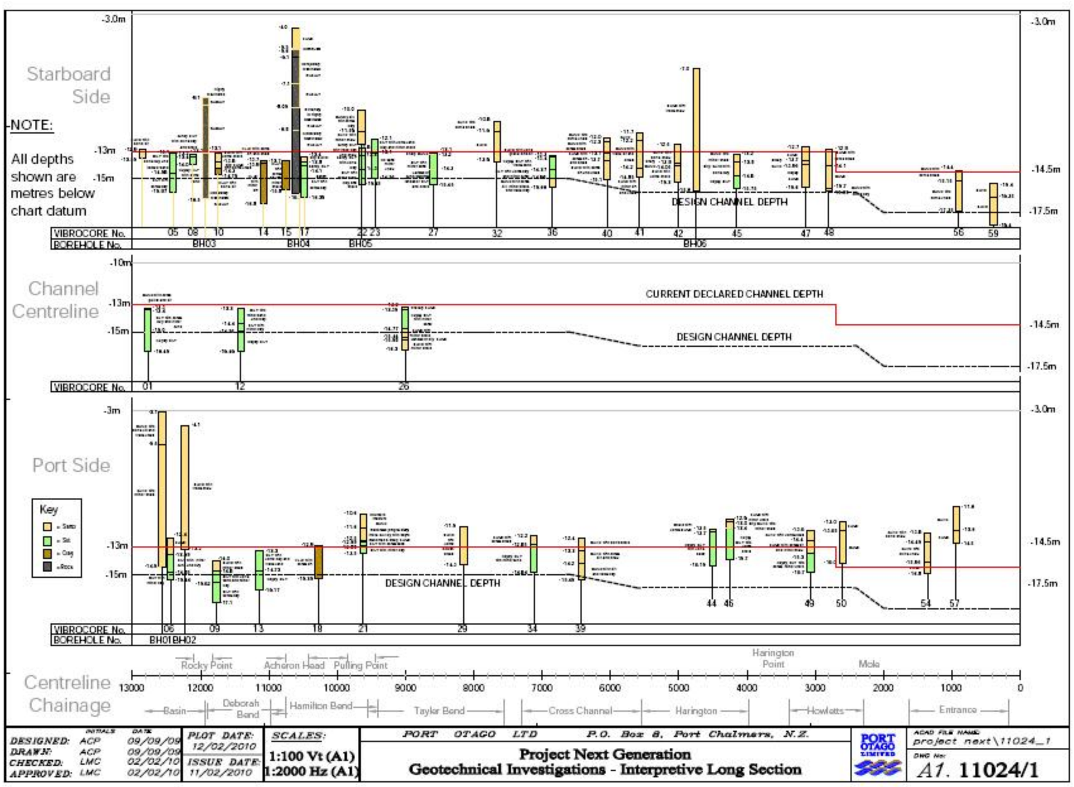


Figure 10 Geotechnical Investigations – Interpretive Long Section

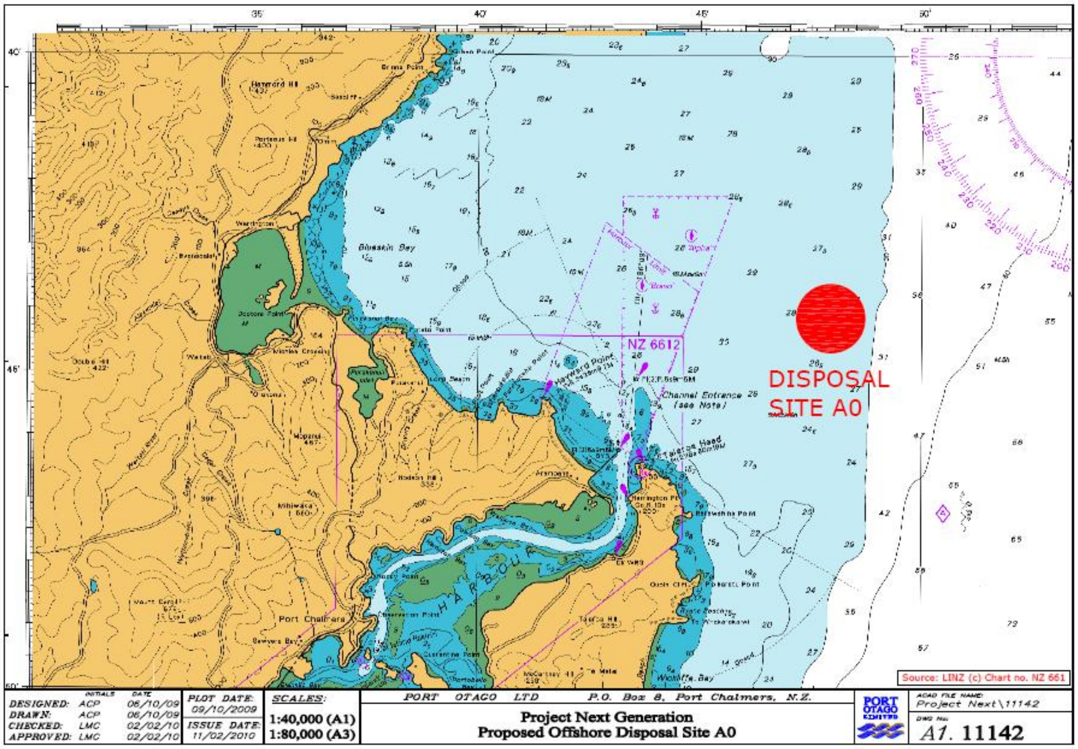


Figure 11 Proposed Offshore Disposal Site A0

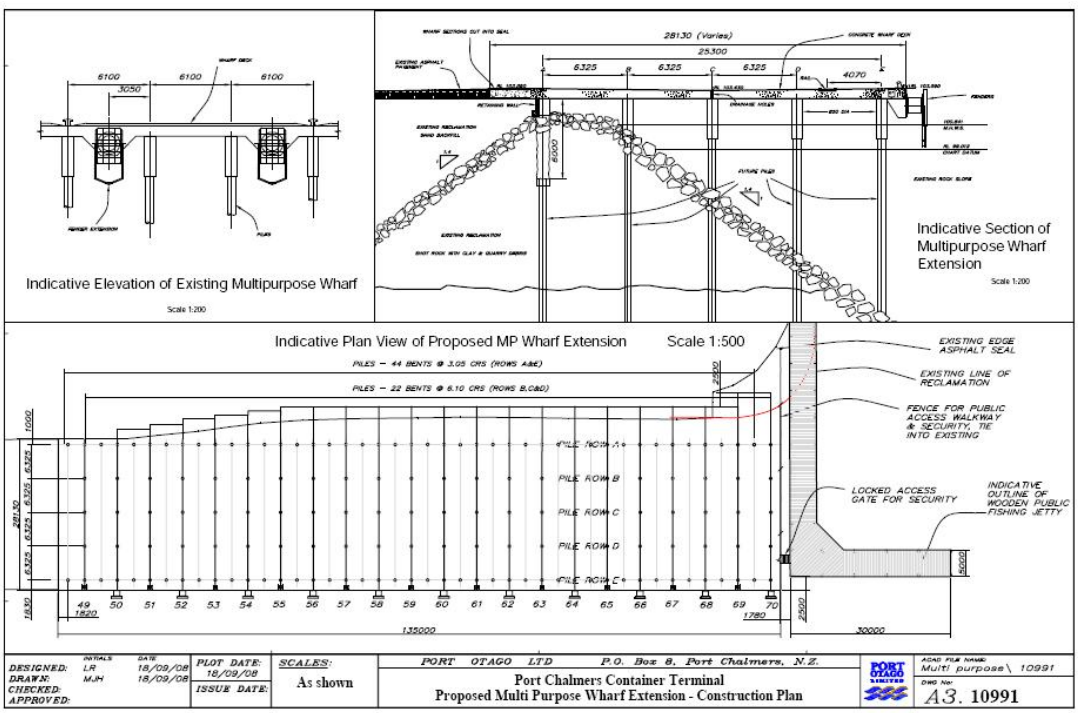


Figure 12 Proposed Wharf Extension – Construction Plan

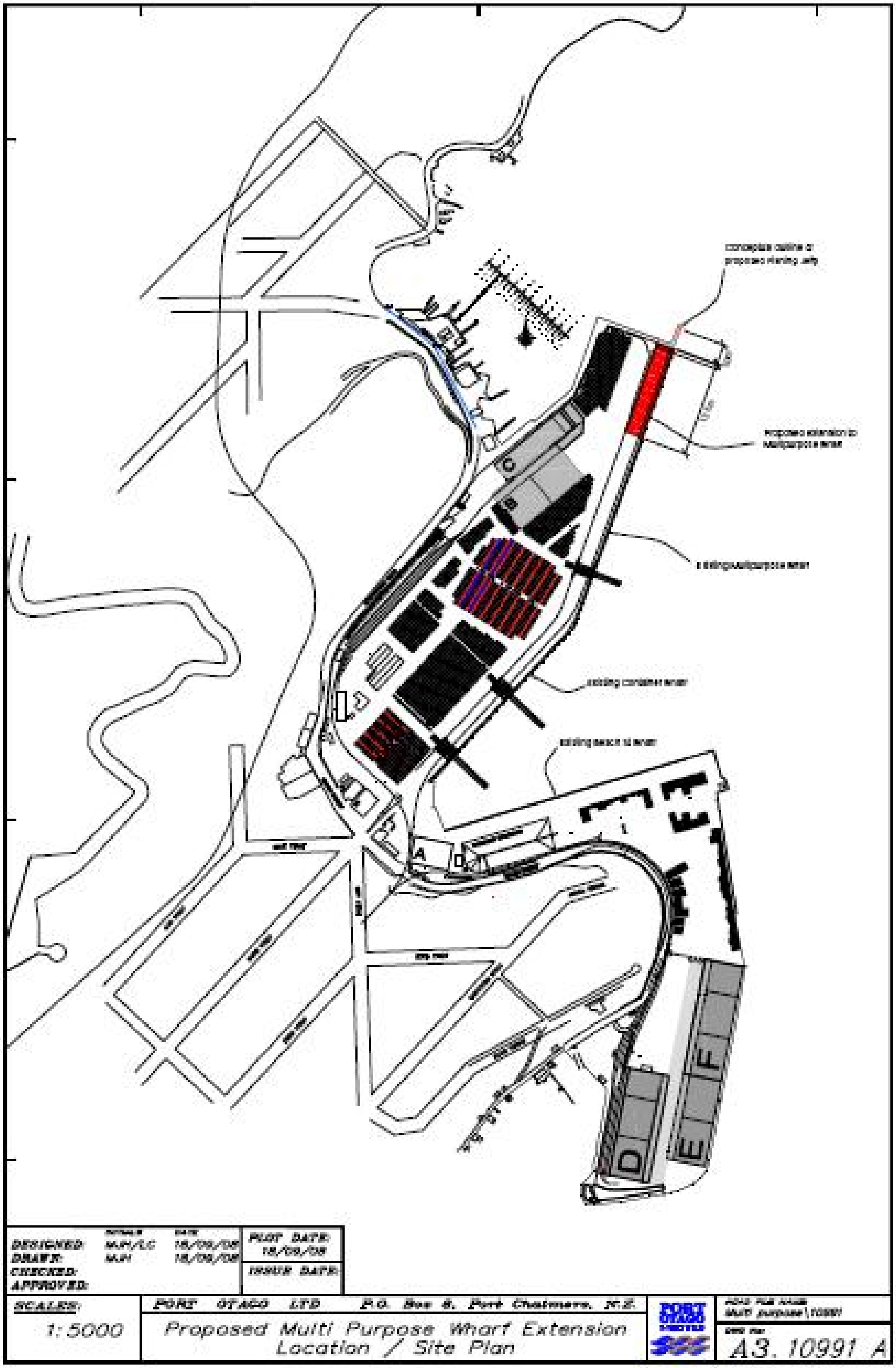


Figure 13 Proposed Multi Purpose Wharf Extension – Location / Site Plan

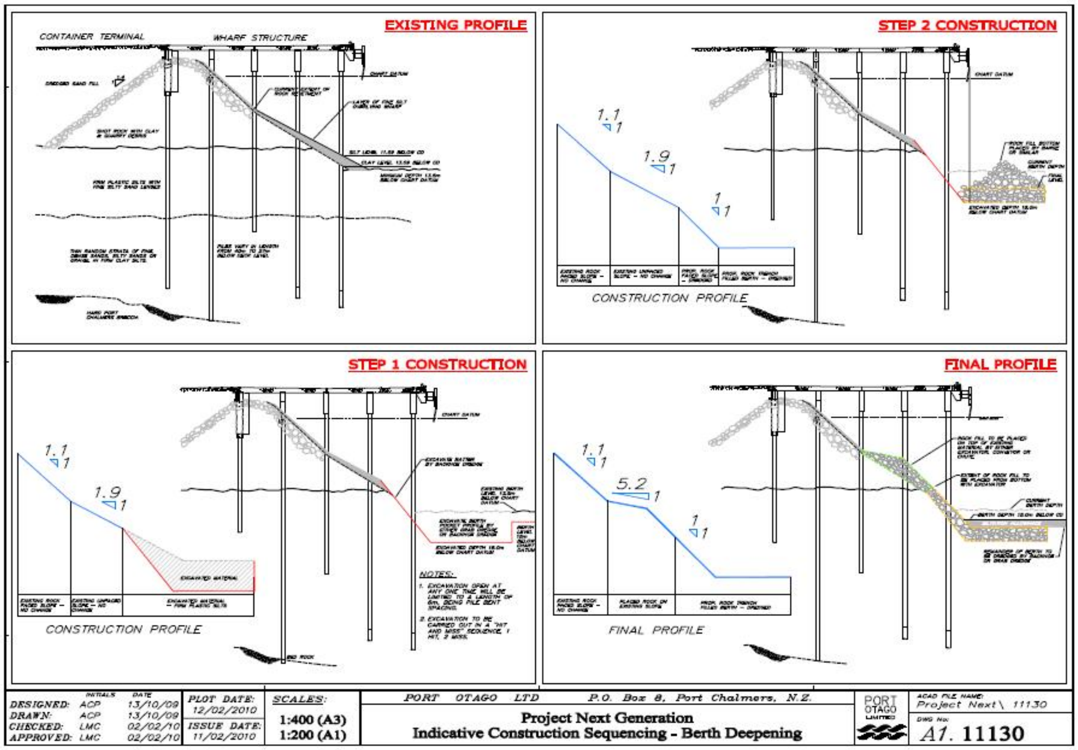


Figure 14 Indicative Construction Sequencing – Berth Deepening