**BEFORE THE WHANGAREI DISTRICT COUNCIL AND NORTHLAND REGIONAL COUNCIL**

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| **IN THE MATTER** | of the Resource Management Act 1991 |
| **AND** | |
| **IN THE MATTER** | of a resource consent application by Northport Limited under section 88 of the Resource Management 1991 for a port expansion project at Marsden Point |
| **APPLICATION NO.** | APP.005055.38.01<br>LU 2200107 |

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**STATEMENT OF EVIDENCE OF JAN MARIE STANWAY**

**(STRUCTURAL)**

**24 August 2023**

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**Counsel instructed:**
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**Solicitors acting:**
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## INTRODUCTION

### Qualifications and experience

1. My name is Jan Marie Stanway (married name Stevenson).

2. I am a Technical Director – Marine & Building Structures employed by WSP New Zealand Limited (WSP).

3. I have over 29 years' experience in design and construction of buildings and marine structures. My specialist field is structural engineering and the seismic performance of structures.

4. I am a chartered professional engineer, and hold the following qualifications:

   - Bachelor of Engineering (BE) (Civil)(Hons)
   - Chartered Member (CMEngNZ) with Engineering NZ
   - Chartered Professional Engineer (CPEng) with Engineering NZ

5. I prepared, with input from Mr Kevin McManus (geotechnical expert) and Mr Noel Band (construction expert), the Concept Design Report for the proposed new berth (Berth 5) to the east of the existing Northport wharf infrastructure, which was attached to the application as Appendix 18 ("the Report").

6. I am familiar with the application site although I have not visited the site. I have read the relevant parts of: the application; submissions; and the Section 42A Report.

### Code of Conduct

7. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

## SCOPE OF EVIDENCE

8. In my evidence, I:

   (a) Provide an executive summary of my key conclusions;

(b) Briefly describe my role in the project;

(c) Summarise the basis of the concept design, including setting out the stakeholder user requirements and seismic considerations;

(d) Provide a summary of the conceptual wharf design including alternative designs considered;

(e) Discuss the proposed construction methodology and programme as prepared by Mr Noel Band;

(f) Respond to submissions raised;

(g) Respond to the s42A Report; and

(h) Comment on proposed conditions advanced by Northport.

**EXECUTIVE SUMMARY**

9. A concept design for the proposed new Berth 5, was prepared based on stakeholder user requirements developed with Northport. Whilst the actual structural form for the wharf may change through a detailed design process, the structure described in the Report and summarised below is a likely outcome and provides a good basis for the assessment of effects.

10. The concept design provides for a 250m wharf and container berth to the east of the existing 570m of Berths 1 – 3 frontage and the 270m length allocated for the future Berth 4. This will enable a total berth length of 1,090m. I understand the proposed new Berth 5 will provide a dedicated container handling terminal at Northport.

11. The proposed structural form for the new Berth 5 wharf is an open piled wharf structure using 914mm overall diameter concrete filled steel piles supporting a suspended concrete deck.

12. The wharf structure piles would be at typical 6m spacing along the main wharf area and arranged in pairs at 6m spacing under the seaward crane rail. A single row of piles at 3m centres would be provided under the landward crane rail. The land behind Berth 5 is retained with a retaining wall at the rear of the wharf along with a sloped rock revetment under the wharf. Figure 1 below provides an indicative cross section of Berth 5.

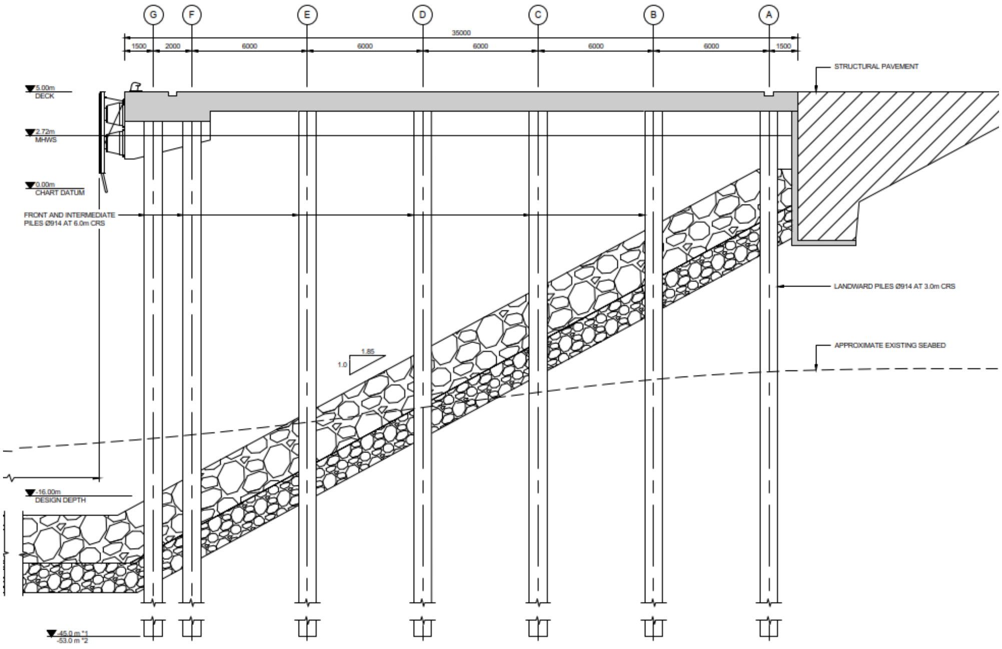


Figure 1 – Indicative cross section of Berth 5

13. The new wharf design accommodates Super Post Panamax[1] twin-lift[2] or Super Post Panamax tandem-lift[3] ship to shore container cranes (including the option to carry hatch platforms).

14. The wharf will include fenders on the edge of the wharf.

15. Bollards will be located along the wharf face along with flush mounted shore bollards located in the backlands.

16. The area behind Berth 5 will be reclaimed using excess dredged material from the proposed turning basin and, combined with the already consented reclamation behind Berth 4, will provide approximately 16Ha of paved hardstanding.

17. The eastern edge of the new hardstand will be contained with approximately 230m length of rock revetment placed along the eastern edge of the reclamation. Refer to Figure 2 below.

[1] Super Post Panamax ship to shore cranes refer to the size of the vessel that the cranes can service. For Super Post Panamax the cranes can service container vessels with up to 22 container boxes across the width of the deck.
[2] Twin lift – crane can lift 2 x 20ft containers end on end.
[3] Tandem lift – crane can lift 2 x 40ft containers side by side.

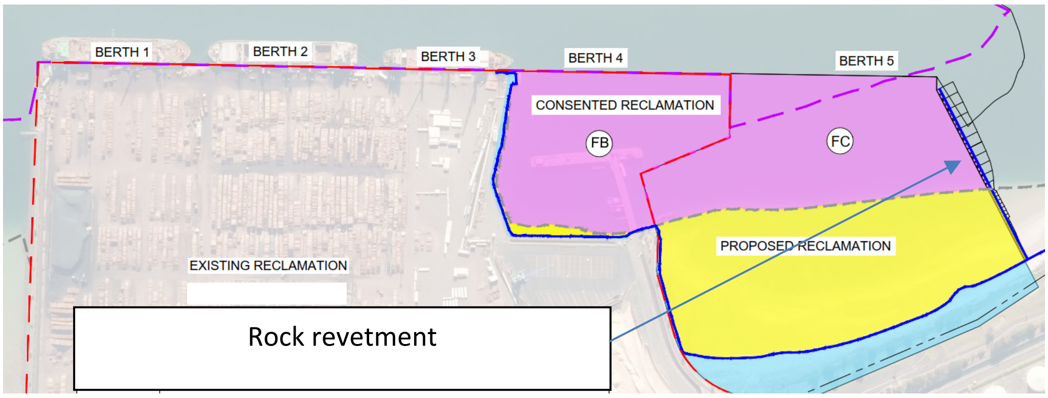


Figure 2: Location of rock revetment containing eastern edge of reclamation

18. All stormwater on the wharf and hardstand will be retained and conveyed to the existing Northport stormwater management system, refer to the Hawthorne Geddes stormwater report.

19. The proposed extension to the container yard is located to the east and immediately adjacent to the existing Northport wharf frontage. The container yard will require services including wastewater, potable water, fire protection, power and general yard lighting.

20. The reclaimed sand fill will require ground improvement. Typical ground improvement methods include deep soil mixing where the ground is solidified using lime or cement introduced into the soil mass through the use of a rotating in-place mixer, stone columns where the ground is densified by vibration and displacement with gravel to form columns within the ground, and vibro-compaction where the ground is densified by vibration with a vibroflot hung from a crane.[4]

21. The construction period determined by Mr Noel Band is approximately three and a half years including nine months for dredging and construction of reclamation (including filter layers), followed by two years of pile installation.

## MY ROLE IN THE PROJECT

22. I have been involved in this Project since 24 September 2020. My involvement has included providing initial design advise to Northport for a new wharf and preparing the Report.

23. I prepared, with input from Mr Noel Band and Dr Kevin McManus, the Concept Design Report for the proposed new berth (Berth 5) to the east of the existing Northport wharf

[4] "Earthquake geotechnical engineering practice – Module 5. Ground improvement of soils prone to liquefaction", November 2021, NZGS & MBIE.

infrastructure, which was attached to the application as Appendix 18 ("the Report"). I relied upon the inputs of Dr Kevin McManus (Director McManus Geotech Ltd, BE(Civil)(Hons), ME(Civil), PhD(Geotechnical Engineering), with over 35 years' experience in geotechnical earthquake analysis and design for ports, harbour and marine structures) for the geotechnical aspects of the Report, in particular Section 7 of the preliminary geotechnical analysis including the estimated pile sizing and pile lengths and the requirement for ground improvement of the reclamation as discussed in Section 6, and Mr Noel Band (Director of Construction Logic, BSc (Civil Engineering), CPEng, FEngNZ, with 45 years' experience in design and construction of structures) for the proposed construction methodology, plant and estimated construction and pile driving programme, Sections 9, 10 and 11 of the Report.

24. Basin dredging, dredge volumes and construction sequencing of the reclamation are excluded from the Report. WSP provided high-level advice to Northport regarding the basin dredging, construction of the new reclamation and seawall options. This initial assessment and advice was undertaken by Mr Melvin Auld (WSP Technical Principal, MEng, CPEng, with 20 years' experience of structural and heavy civil engineering, including 10 years seismic design experience, over 3 years' experience in design of marine structures and port infrastructure), Mr Gary Chalmers (WSP Technical Principal, BE(Hons)(Civil), CPEng, MICE, FEngNZ, with over 50 years' experience of structural, geotechnical, heavy civil and seismic design of marine structures and port infrastructure), and WSP sub-consultants Dr Kevin McManus and Mr Noel Band. Northport assessed vessel navigation.

**BASIS OF CONCEPT WHARF DESIGN**

25. A conceptual design for the new wharf structure and container terminal yard has been developed for the proposed Northport extension. The methodology adopted in preparing the concept is set out in the Report.[5] The concept design is indicative only and does not constitute a preliminary design. It provides sufficient detail for robust effects assessments by others but does not constitute a preliminary design.

26. The concept design has progressed based on information from Northport regarding the existing bathymetry, required berth pocket depth, sediment transport and existing geotechnical information from the port. If changes to vessels or vessel draught occurs, or if bathymetric, geomorphological or geotechnical information is later updated as a result of additional investigations, some of the concept design may need to be amended.

[5] Section 5.

### Stakeholder User Requirements

27. Stakeholder user requirements for the container terminal were provided to WSP by Northport. These informed the development of the design proposal and the concept design developed by WSP allows for these user requirements. The user requirements are set out in the Report[6] and are summarised as follows:

(a) The proposed design berth depth along Berth 5 is -16m CD. This allows for dredging tolerances and siltation build up. Note that, whilst it is possible that the full berth pocket depth may not be required in the initial service of the new wharf, the construction of the new wharf will limit access under the wharf to construct the revetment slope. This means that the full dredged depth is required to at least the toe of the revetment slope to enable the revetment slope, including scour protection, to be completed before the wharf deck is constructed.

(b) The dredge material used for the proposed reclamation will be harvested as part of the facility construction. Imported fill (sand and hardfill) may also be used to form the reclamation.

(c) Wharves 4 and 5 will support the ship to shore cranes. The following equipment was selected as a suitable basis for the concept design of the Berth 5 wharf:

- Liebherr Super Post-Panamax twin lift crane
- Liebherr Super Post-Panamax tandem lift crane
- Potential inclusion of hatch platform positions on the landside of crane legs

(d) Fendering and bollards are to be designed for an indicative design vessel of approximate capacity of 9000 TEU.[7] The final fendering and bollards chosen will be confirmed during detailed design when the design vessel is confirmed.

(e) Heavy-duty pavement to support operational loads in the container terminal.

[6] Refer to Section 3.
[7] TEU = twenty-foot equivalent unit.

(f) The new wharf is to be designed to be Importance Level 2[8] as defined by AS/NZS 1170.0[9] with a 50-year design working life.[10] In accordance with AS/NZS 1170.0 the Importance Level and Design Working Life are used to determine the annual probability of exceedance for seismic design actions to achieve compliance with the New Zealand Building Code.

**Operational and Seismic Considerations for Reclamation**

28. The dredge material used for the proposed reclamation will be harvested as part of the facility construction. The existing geotechnical investigation data for Berths 1, 2 and 3, as provided by Northport, indicates that dredged sands would be the predominate material encountered at Berth 5 with isolated silty sand and clayey sand layers.

29. The dredged material used for the reclamation will require densification to render it suitable for support of typical container storage yard operational load demands (e.g. loads from stacks of containers, forklift wheel loads, truck loads, straddle carriers and/or automated gantry cranes) and provide stability to the revetment slope below the wharf.

30. In addition to achieving suitable support for the container storage yard, based on the existing geotechnical investigation data, a conceptual liquefaction assessment has been undertaken that suggests that at the design levels of seismic shaking, some liquefaction of the upper layers of the seabed and reclamation fill that is deposited through a water column may be experienced which will impact the performance of the container storage yard and can increase displacement of the wharf during seismic shaking. Some densification and improvement of these liquefiable layers will be required as part of this project.

31. Densification of the reclamation may include ground improvement methods such as deep soil mixing, stone columns or vibro-compaction.[11]

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[8] The importance level of a structure is determined in accordance with its occupancy and use. Importance Level 2 (IL2) is for normal structures.
[9] AS/NZS 1170.0:2002 "Structural design actions – Part 0: General principles", Standard New Zealand & Standards Australia.
[10] Design working life is a reference time period expressed in years. It is a concept used to select the probability of exceedance of different actions. This does not mean that when the design working life is reached the structure will fail; nor does it mean that the design working life has to correspond exactly with the intended useful life the designer has in mind or with the durability of the constructed materials. Once the 'importance level' and the 'design working life' are determined for a structure, the annual probability of exceedance of an action can be determined. A 50-year 'design working life' is assumed for 'normal structures' when using AS/NZS 1170.0 and is based on national and international practice.
[11] "Earthquake geotechnical engineering practice – Module 5. Ground improvement of soils prone to liquefaction", November 2021, NZGS & MBIE.

## CONCEPTUAL WHARF DESIGN

### Wharf structure options considered

32. Several possible options for the structural form of the proposed Berth 5 wharf were considered and assessed.

33. Images of the various options are included in the Report.[12] The following wharf options were considered:

    (a) "Hybrid" wharf structure similar to Berths 1 and 2;

    (b) Diaphragm wall with tieback anchors;

    (c) Interlocking circular caissons gravel or sand filled;

    (d) Single combi-pile wall with tieback anchors;

    (e) Twin combi-pile wall structure similar to Berth 3; and

    (f) Typical open pile marginal wharf.

34. A range of criteria were considered when assessing the wharf structure to provide the best overall outcome These criteria, and their application to the various possible options, are detailed in the Report.[13]

35. When assessed against the selection criteria, an open piled marginal wharf with rock revetment has the best overall outcome and was therefore the chosen option. This was the only option developed for the conceptual design. In particular, the marginal piled wharf option:

    (a) provides the structural and geotechnical capacity to support the large axial loads arising from the ship to shore crane loads;

    (b) provides seismic displacement capacity, resilience and post seismic event functionality (following a 1 in 225-year seismic event);

    (c) utilises a concrete deck which has large load capacity without significant settlement concerns;

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[12] At Section 8.1 of the Concept Design Report.
[13] These are set out in section 8.2 of the Concept Design Report.

(d) is designed using geometry that can be adjusted to respond to minor changes in the User Requirements without necessitating a complete change in construction form;

(e) features durability requirements that can be readily addressed using proven technologies;

(f) utilises simple construction procedure;

(g) contains a bulkhead structure that can be constructed on the eastern corner to tie into the eastern rock revetment; and

(h) offers construction procedures for ground improvement that are expected to be straight forward, with flexibility in the selection of ground improvement technique.

36. The other options considered were found to be unsuitable for the following reasons:

(a) The hybrid wharf would result in two legs of the container crane being supported on the piled portion of the wharf and two legs being supported on the backfilled backlands. This not only has a day-to-day operational risk if the landward crane rail settles relative to the seaward crane rail, but the piled portion will respond differently during seismic events than the backfilled portion resulting in differential movement damage to the wharf and increase in rail gauge as tie rods to the landward rail stretch under load. This would result in higher levels of damage and longer operational outage times would be required post-seismic event compared to the marginal piled wharf option.

(b) The diaphragm wall with tie backs has less deformation capacity in seismic events compared to a piled marginal wharf and would therefore require more extensive, and expensive, ground improvement to achieve the required level of seismic performance. Rail gauge will be more readily compromised as a result of vertical settlement and lateral displacement during a seismic event as well as compromising the pavement between the rails. Repair of the diaphragm wall option will be more challenging than the marginal piled wharf option with a higher risk that the diaphragm wall option would need to be demolished and rebuilt following a major seismic event.

(c) The interlocking circular caissons with gravel or sand infill are expensive. They are a specialised form of construction and New Zealand contractors lack experience in this form of construction. With the added pricing volatility that exists for steel in the global market at present the potential for cost increases is significant.

(d) The single combi-pile wall with tie back option has been discounted due to the significant and expensive ground improvement that would be required to the reclamation to enable this option to achieve the seismic performance requirements. Rail gauge will be more readily compromised. This solution also has corrosion issues above mid tide with potential expensive corrosion protection measures to improve the long-term durability.

(e) The twin combi-pile wall structure has similar issues as the hybrid option discussed above. The landward and seaward crane legs would be supported on structural systems that would respond differently in a seismic event. Rail gauge would be more readily compromised. This solution also has corrosion issues above mid tide with potential expensive corrosion protection measures to improve the long-term durability. The outage times following a seismic event are expected to be considerably longer with more expensive repairs compared to a marginal piled wharf solution. Backfill between combi walls cannot be sand and the fill material must be imported with associated transportation costs and carbon footprint.

**Conceptual pile design**

37. I have relied upon the expertise of the geotechnical engineer, Dr Kevin McManus, to determine the conceptual pile design.

38. The geotechnical engineer's assessment of the general observations from the available borehole logs[14] and the Tonkin + Taylor dynamic load test data[15] from Berth 3 is that the information suggests that the subsurface is variable with no clearly defined bearing stratum and the pile capacity will be derived mostly from side resistance through the sands rather than end bearing.

39. The geotechnical engineer has advised that to support the large axial loads on the wharf due to the ship to shore cranes and achieve the required seismic performance the wharf piles need to be concrete filled circular steel piles. Screw piles do not have the required axial or lateral load capacity required for this wharf. Precast concrete piles have been discounted due to the potential issues with driveability and the reduced deformation

[14] Existing borehole logs from Berth 3.
[15] Tonkin + Taylor dynamic load test data from Berth 3.

capacity, resilience and post seismic event functionality compared with steel cased concrete filled piles.

40. Based on the ship to shore crane loads, a 3m pile spacing along the landward pile row and twin piles at 6m spacing under the seaward crane rail has been considered.

41. The geotechnical engineer has recommended that all piles are driven to the same depth. Based on existing geotechnical information the target driving depth is -50m CD for Super Post Panamax tandem-lift ship to shore cranes and -44m CD for Super Post Panamax twin-lift ship to shore cranes.

42. The concept design selected 914mm diameter steel tubular piles to be driven open ended to minimise pile driving noise and vibration however this increases the duration of the piling activities. Once driven, the piles will be cleaned out and concrete filled.

### Wharf seismic design

43. The seismic design for the proposed Berth 5 is focused on the ability of the wharf structures to sustain the operating level earthquake (minimal damage) and contingency level earthquake (controlled repairable damage) with an acceptable level of damage in accordance with ASCE 61-14 Seismic Design of Piers and Wharves.

## PROPOSED CONSTRUCTION METHODOLOGY & PROGRAMME

44. I have relied upon the expertise of Mr Noel Band to develop the proposed construction methodology, plant and estimated construction and pile driving programme.

45. A summary of a potential construction methodology is included in the Concept Design Report.[16] It is noted that the construction methodology presented in the Concept Design Report is one method that can be used to construct this wharf and is considered to result in the shortest construction programme.

46. The construction methodology assessment expects that construction will take approximately 3.5 years, including 12 months of dredging and reclamation works and 28 months to construct the new wharf. It notes that if one piling spread is utilised (one piling crew and plant) piling activity is expected to occur over a duration of 24 months, however if second piling spread (2nd crew and plant) was set-up that the piling operation duration could feasibly be halved.

[16] See sections 9-11 and Appendix A.

47. A more detailed breakdown of the potential construction programme is included in the Appendix of the Report.

## RESPONSE TO SUBMISSIONS RAISED

48. No submissions were received in relation to the design and construction of the new wharf or the heavy-duty pavement for the container terminal yard.

## RESPONSE TO THE SECTION 42A REPORT

49. In paragraph 458 of the s42A report,[17] the authors' comment:

> *From a resilience perspective, and in recognition of the permanent loss of coastal space, it would be preferrable for this infrastructure to be designed to withstand seismic events to provide a critical lifeline utility service when the region is most vulnerable. There may be nonfinancial reasons why this is not practicable, and the applicant is invited to respond to this in evidence.*

50. I have commented above (refer in particular to paragraphs 27-31, and 43) on the seismic design parameters adopted for the wharf. I remain of the view that the design is appropriate for a wharf of this nature which includes the ability to sustain earthquake events to an acceptable level of damage in accordance ASCE 61-14 Seismic Design of Piers and Wharves. The initial advice from Northport in 2020 was that Berth 5 would be designed as an Importance Level 3 (IL3) structure, however Northport have advised that the new Berth is to be designed for IL2 based on recent discussions with Northland CDEM. For further specific information as to why the design of Berth 5 to Importance Level 2 in AS/NZS 1170.0 was selected, please refer to the evidence of Mr Greg Blomfield.

## COMMENT ON PROPOSED CONDITIONS ADVANCED BY NORTHPORT

51. I agree with the NRC conditions proposed by Northport in relation to design and construction of the new wharf and heavy-duty pavement in the container yard.

**Jan Stanway**
WSP New Zealand Ltd

24 August 2023

[17] Dated 3 August 2023.