BEFORE THE HEARING COMMISSIONERS
NAPIER

IN THE MATTER	of the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	of applications by Port of Napier Limited to undertake wharf expansion, associated capital and maintenance dredging, disposal of dredged material within the coastal marine area, and occupation of the coastal marine areafor existing port activities and the proposed new wharf

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STATEMENT OF EVIDENCE OF CHRISTOPHER ALEXANDER ADAMANTIDIS

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INTRODUCTION

Qualifications and experience

1. My name is Chris Adamantidis. I am a Principal Coastal Engineer at Advisian, which is the independent consulting business line of WorleyParsons, based in Sydney, Australia. I have 22 years' professional experience in all aspects of coastal and estuarine hydrodynamics, beach erosion, sediment transport, shoreline evolution, coastal zone management, coastal structure analysis and design. I have undertaken investigation, designs, numerical sediment transport and hydrodynamic modelling and physical modelling studies for breakwaters and revetments subject to wave attack, as well as high level hydraulic analyses. I have undertaken numerous coastal hazard analyses, studies of coastal processes and design studies both in Australia and other countries including Samoa, Papua New Guinea, Tonga, Ghana and Bangladesh.

2. I am a Member of Engineers Australia, which is Australia's principal engineering association. I hold a Bachelor of Engineering (Environmental) Hons., 1996 and a Master of Engineering Science (Coastal/Water Quality), 2000, both from the University of New South Wales.

3. My work history is as follows:

2012 to present	Principal Coastal Engineer, WorleyParsons Services Limited and Advisian Pty Ltd.
2007 to 2012	Manager, Coasts and Estuaries, SMEC Australia, Sydney
2001 to 2007	Senior Coastal Engineer, SMEC Australia, Sydney
1996 to 2001	Project Engineer, University of NSW Water Research Laboratory, Sydney

Involvement in project

4. I have been involved in Napier Port's wharf and dredging project (the project) since 2015, in particular the dredge plume modelling studies and detailed assessment of surfability. Throughout the project I have worked closely with Dr Ben Williams, who is providing comprehensive evidence in

relation to Advisian's input into the project, including some of the areas I worked closely on. I am familiar with the reports prepared by Advisian which form part of the project documentation.

5. I was also involved in the expert caucusing that took place on 20 July 2018 in my capacity as a coastal engineer with involvement in the coastal process investigations and dredge plume modelling for the project.

Expert Witness Code of Conduct

6. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 December 2014. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Purpose and scope of evidence

7. This evidence summarises the aspects of the work which I was involved in and the main findings of that work.

8. I have led the following aspects of the studies that have been carried out in support of the Resource Consent Applications:

    - Dredge plume dispersion modelling carried out to assess the impact of dredging at the proposed port navigation channel and disposal at a proposed offshore spoil disposal area – this is the subject of the report in Appendix E of Volume 3 of the Resource Consent Application documentation.

    - The assessment of the impact of the channel dredging on surfing amenity at the recognised surf breaks at "Hardinge Road" and "City Reef", included in Appendix D of Volume 3.

9. The purpose of the dredge plume modelling studies outlined in this evidence was to assess the dispersion of the suspended sediments generated both at the site of the proposed dredging activities within the channel and Port area, as well as the dispersion of the dredged material at the proposed offshore disposal area. The output from the modelling includes a spatial assessment of the predicted

suspended sediment concentration in the vicinity of the dredging area and disposal area, above background levels.

10. The purpose of the assessment of the impact of the channel dredging on surfing amenity at the recognised surf breaks was to address concerns raised during the consultation undertaken by the Port regarding the potential impact of the deeper channel on surfing amenity at the surf breaks. The Port requested Advisian to undertake this assessment for the surf breaks at Hardinge Road and City Reef, using the results of spectral wave modelling carried out for the project.

11. The evidence also provides a response to specific matters raised in the Section 42A report and specific Conditions of Consent relating to the aspects of the project in which I have been directly involved.

12. The evidence addresses separately the following specific topics that were raised in various submissions:

    (a) Dredge Plume Modelling - Adequacy of Basis for Model

    (b) Disposal of Dredge Material further offshore

    (c) Effects in and near to Ahuriri Estuary

    (d) Adequacy of the modelling in relation to potential cultural impacts, in relation to the representativeness of the base conditions, and the duration of the simulation

    (e) Impacts of the project on surfing amenity.

Summary of Conclusions

13. Based on the outcome of the calibration and validation of the various numerical models used to assess the dredge plume dispersion against measured field data, and the extent of available data used to assess the effects of the project, I consider that the dredge plume modelling presented in Appendix E of the Resource Consent Application is sound and in accordance with industry best practice. I consider also that the results of the modelling can be relied upon for assessing the spatial impact of the proposed dredging on suspended sediment concentrations above background levels during the dredge campaigns.

14. Based on the surfing amenity assessment that I have documented in Chapter 6 of Appendix D of the Resource Consent documentation, I conclude that the proposed dredging would have little impact on the surfing amenity at the surf breaks at City Reef and Hardinge Road.

15. Due to the direction of prevailing currents as obtained from long term field measurements undertaken by the Port, and the shallower depth at the inshore disposal ground when compared with the offshore disposal area, my opinion is that there would be greater potential for a temporary increase in suspended sediment concentrations at Pania Reef if disposal were to occur at the inshore spoil disposal area.

16. In my experience as a coastal engineer, I am not aware of any established method that can be applied to the dredged material within a dredge hopper to obtain material with a grain-size distribution that would meet the suitability criteria to allow it to be used as beach nourishment as proposed by Council staff in Condition 17 of the Draft Conditions of Consent CL180010E and CL180010E, and Condition 18 of the Draft Conditions of Consent CL180009E.

17. My opinion is, therefore, that Council staff's proposed condition to provide suitable material for beach nourishment at Westshore Beach cannot be met if dredged sediments are to be used for this purpose. This is based on the assessed effectiveness or suitability of the dredged material for this purpose and the lack of an established treatment process that can be applied to the dredged sediments to allow them to be considered suitable for beach nourishment.

DREDGE PLUME DISPERSION MODELLING

18. The dredge plume dispersion modelling that I undertook as described in Appendix E of the Resource Consent Application documents describes the dispersion of suspended sediments during the capital dredging campaigns.

19. To undertake the dredge plume dispersion modelling, I set up a three-dimensional hydrodynamic model using the DELFT3D-FLOW module, which is used to simulate tidal and wind-driven currents. The hydrodynamic (and transport) simulation program calculates non-steady flow and transport phenomena that result from tidal and meteorological forcing on a curvilinear, boundary fitted grid.

20. The dredge plume modelling study required setting up a 3D hydrodynamic model that covered the entire Hawke Bay area, with higher resolution in the vicinity of the Port.

21. The hydrodynamic model included six vertical layers which allowed the variation in suspended sediment concentration above background levels with depth to be assessed. The inclusion of the layers allowed for the 3D hydrodynamic effects to be fully considered in the modelling as well as allowing for dredge material to be introduced at different depths within the water column, to schematise accurately what would actually occur during the dredging campaign.

22. The hydrodynamic model was coupled to a separate wave model and water quality model (D-WAQ PART, a 3D random walk particle tracking model which is part of the Delft 3D suite and is coupled to the hydrodynamic model.)

23. Essential information provided by the Port for the dredge plume modelling that was used in my assessment included:

    (a) Detailed geotechnical information about the sediments, including sediment fall velocity distribution by mass from vibrocores at nine locations near the navigation channel.

    (b) Estimates of volume of material to be dredged and the geological unit from which the sediment derives from each dredging campaign.

    (c) Detailed high resolution bathymetric data over the domain of the model including high-resolution bathymetric charts covering Hawke Bay, detailed soundings carried out in the vicinity of Napier Port by Napier Port Ltd. in 2011 and 2014 and beach profiles and soundings obtained from Hawke's Bay Regional Council and the Port undertaken to the north and west of the Port derived from both land and nearshore surveys.

    (d) Measured currents at various locations throughout the model domain. ADCP data at a downward facing ADCP mounted on a buoy, at a location in approximately 10 m water depth west of the navigation channel was available. This information was used for calibration and validation of the hydrodynamic model, to provide confidence that the model can accurately reproduce the observed

currents at multiple locations and over multiple time periods.

(e) Measured wind speeds at the Napier breakwater, assumed to apply over the entire model domain.

(f) Tidal conditions in the Napier area used to provide boundary conditions for the modelling.

(g) Wave forcing simulated using a calibrated and verified SWAN wave model developed by my colleague Ben Williams, coupled to the 3D hydrodynamic model. The purpose of this was to schematise wave induced near bed current velocities, near bed shear-stresses induced by the waves and, hence, the potential for dredged sediments to be re-suspended or remain in suspension.

(h) Characteristics of the proposed dredge plant to be used provided by the Port, including sailing time, vessel draft and hopper capacity. This information was used to define in which layer of the model the sediments should be released in the water column as well as the timing, duration and quantities of the sediment releases from the dredging areas and at the dredge disposal area. The characteristics of the proposed dredge plant also allowed an estimation of the duration of the individual dredge campaigns.

(i) Information from scientific literature on critical shear stresses for erosion and deposition, as well as horizontal and vertical dispersion parameters.

24. Eleven separate particle size classes were modelled which covered the range of dredged sediments from clay size particles through to coarse sand. I estimated the volumes of these sediment classes individually based on the characteristics of the sediments as gleaned from the available geotechnical data.

25. Based on information provided by the Port it was considered that the dredging would be undertaken in a series of campaigns or stages. I chose a modelling period that represented the impact that would occur over the course of a dredging campaign that included a larger volume and hence longer duration of continuous Trailer Suction Hopper dredging, thus providing a conservative model scenario.

26. I undertook an analysis of ten years of wind data to identify a suitable period over which to apply the dredge plume dispersion model. The analysis found that the period from May to August 2016 included individual wind events that represented a relatively stormy period with greater potential for re-suspension and transport of dredged sediments. For this reason it was selected as a suitable base period over which to undertake the dredge plume dispersion modelling as it would provide a relatively conservative assessment of the potential effects.

27. The model results were presented in our report as percentile exceedance maps of near surface total suspended sediment concentrations above background levels, in mg/L, over the modelling period (i.e. encompassing the length of the individual dredging campaign). Separate cross-section plots of the 98%ile (i.e. exceeded only 2% of the time during the dredge campaign) total suspended sediment concentrations above background levels with depth were presented, to illustrate the variation of suspended sediment concentration with depth. These concentrations were predominantly represented by the silt and clay fractions of the sediment, as the sand fractions settle out relatively quickly and do not have the opportunity to travel very far from their initial source locations. These maps showed that the predicted area where 98%ile suspended sediment concentrations would exceed 10 mg/L above background levels does not affect the Significant Conservation Area around Pania Reef.

28. Additionally, maps illustrating the expected bed deposition of the silt and sand fractions during the dredge campaign were presented. These maps illustrate that a maximum of 1 mm of deposition of fine sediment within the Significant Conservation Area around Pania Reef could be expected.

29. Further to the above evidence presented in the report in Appendix E of the Resource Consent Application, I have been involved in validating the dredge plume dispersion modelling against field data that was collected on behalf of the Port over the course of two days during a maintenance dredging campaign that was undertaken by the Port in October – November 2017. The Dredge plume properties compared between field and model include:

(a) Vertical structure of the plumes – variation in Total Suspended Sediment (TSS) concentrations with depth within the plume

(b) Horizontal extent of the plumes, their evolution and horizontal excursion with time

(c) Horizontal variations in TSS concentrations within the plumes – i.e. the intensity of the plume as well as measured vs. modelled TSS concentrations.

30. In my opinion, the dredge plume model provided a good representation of the structure of the plume with depth. Comparison of 3D-modelled TSS concentrations with CTD casts in the plume for three different disposal events at two different locations indicated that the model provided a good representation of TSS concentration with depth within the plume at the disposal sites.

31. It was found also that for the disposal events examined, the measured depth-averaged TSS along the drogue track closely matches the modelled values along the same track, indicating that the model provides a good validation of the spatial extent of the plume and the TSS concentrations with horizontal distance.

32. The modelled plumes of surface TSS in mg/L compares favourably with that measured in the field for all disposal sites examined. The spatial extent of the plumes, plume excursion and peak concentrations are represented accurately in the model for all disposal events examined. Figure 1 and Figure 2 present the results of the validation of the dredge plume dispersion modelling against field data collected during the maintenance dredging campaign undertaken in October 2017.

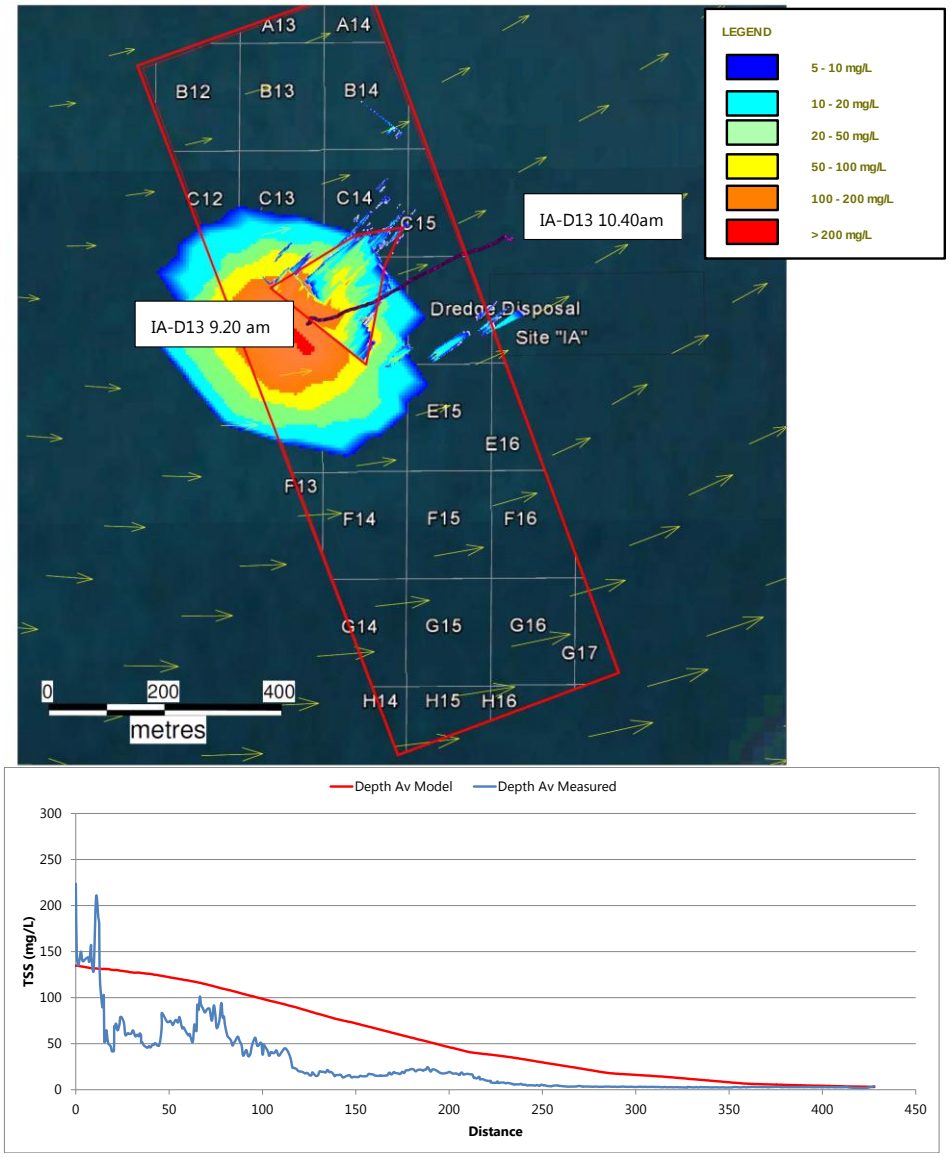

Figure 1 - Top – Measured backscatter from ADCP vs modelled plume at 10.20 am 18 October. Drogue track from 9.20am to 10.40am. Arrows indicate modelled current direction. Bottom – Depth-averaged TSS modelled vs. measured along drogue track

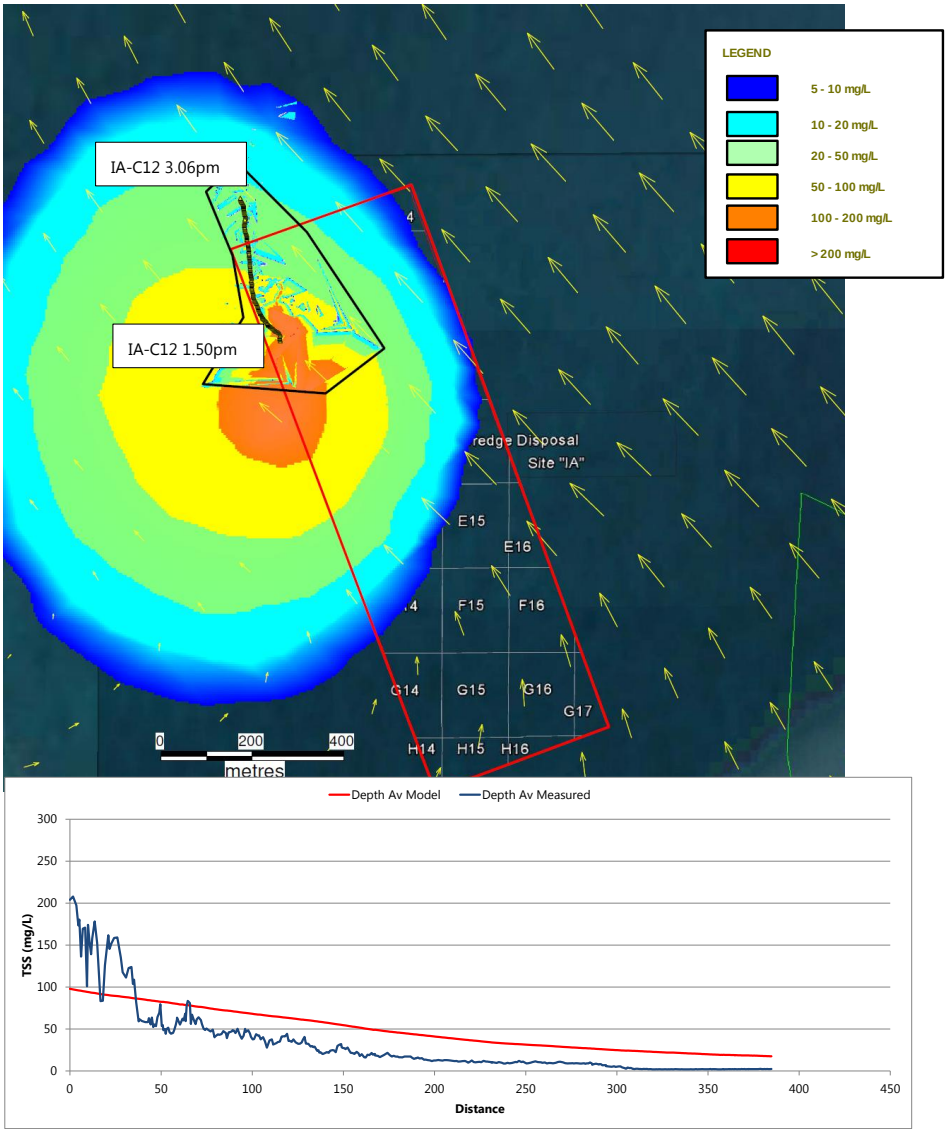

Figure 2 - Top – Measured backscatter from ADCP vs modelled plume at 1.50 pm 18 October. Drogue track from 1.50 pm to 3.06 pm. Arrows indicate modelled current direction. Bottom – Depth-averaged TSS modelled vs. measured along drogue track.

33. Based on the outcome of the calibration and validation of the various numerical models used to assess the dredge plume dispersion against measured field data, and the extent of available data used to assess the effects of the project, I consider that the dredge plume modelling presented in Appendix E of the Resource Consent Application is sound and in accordance with industry best practice. I consider also that the results of the modelling can be relied upon for assessing the spatial impact of the proposed dredging on suspended sediment concentrations above background levels during the dredge campaigns.

IMPACT ON SURFING AMENITY

34. In 2017 I carried out an assessment of the potential impact of the dredging on surfing amenity at the surf breaks at Hardinge Road and City Reef.

35. That assessment was requested by the Port in response to concerns raised during the Port's consultation about the potential for impacts of the proposed dredging to surfing at the identified surf breaks. The assessment is documented in Chapter 6 of the Advisian Report in Appendix D of the Resource Consent Application documents.

36. In undertaking my assessment, I have used the results of the calibrated and verified SWAN spectral wave model described earlier in the Appendix D report and developed by my colleague, Ben Williams, to derive a series of transformed wave conditions at the two surf breaks at Hardinge Road and City Reef. The range of offshore wave directions, periods and significant wave heights run through the SWAN spectral wave model correspond to the measured wave parameters from the Triaxis buoy over the ten-year period from 2004 to 2014.

37. Using this method, 10-year wave time-series were derived at eight discrete locations corresponding to various points within each of the surf breaks, to compare wave conditions that would have occurred under existing conditions with those which would be predicted following the channel dredging.

38. I assessed the impact on surfing amenity with respect to the methodologies described by various scientific literature on this subject, including Mead (2003), Lewis *et al.* (2015), Mead (2001), Walker (1974) and Hutt *et al.* (2001). These methods describe the surfing amenity in respect of various parameters including peel angle, breaker intensity and breaking wave height.

39. In Chapter 6 of the Appendix D report, I plot the pre and post-dredging wave characteristics described above at each of the surf breaks on the surfing amenity classification nomograms provided by Walker (1974) and Hutt *et al.* (2001).

40. These plots show that there would be minimal change to the surfing amenity at City Reef as a result of the proposed dredging, with very little change in peel angle and only a

slight increase in the proportion of plunging breakers when compared with spilling breakers.

41. The assessment showed that at Hardinge Road, there would be a slight increase in the peel angle, caused by a clockwise rotation in the approach direction of the waves. This slight increase would result in very little change in surfing amenity, with a slightly higher proportion of waves being assessed as surfable following the dredging, due to the predicted increase in peel angle.

42. From the surfing assessment I conclude that the proposed dredging would have little impact on the surfing amenity at the surf breaks at City Reef and Hardinge Road.

RESPONSE TO MATTERS RAISED IN SECTION 42A REPORT

43. In relation to the aspects of the project raised within the Section 42A report with which I have been directly involved, I provide the following responses.

Disposal of Suitable Material for Beach Nourishment

44. I refer to Subparagraph 3 of Paragraph 10 of the Section 42A report, part of which reads:

> "*The final matter that needs to be addressed in the evidence supplied by the applicant and finalised at the hearing is the intended pathway to mitigate the effects that the proposed dredging of the channel will have on the sediment supply to the eroding Westshore Beach. However, there is a lack of detail and analysis of the nearshore disposal effect on coastal process and marine ecology included in the application as it is focussed on a single offshore disposal location around the 20 m depth contour.*"

45. In relation to this, the report author states the view that "*…this mitigation should be managed through a condition of consent requiring nourishment*".

46. In response to the above, the Section 42A report notes on Paragraph 193, Page 52 that "*The applicant accepts that the results of this early alternatives assessment were indicative only and that a more detailed assessment was required for the current applications. Keeping in mind the scope and level of analysis of this initial assessment, Site 1 appeared to have a substantially greater potential adverse effect on Pania Reef than other options. Furthermore, based on this initial assessment, Site 1 was shown to have the*

greatest potential to affect Town Reef." I note that Site 1 corresponds to the 'RExt' disposal area referred to in the proposed conditions of consent relating to disposal of suitable material for beach nourishment.

47. In relation to the above, as noted in my report in Appendix E, "*Previous modelling carried out for dredge disposal at the "inshore" spoil ground to the west of the navigation channel found that there was a potential for dredge plumes to impact the southern tip of Pania reef, with fine sediment deposition possible, albeit limited due to the effects of sediment re-suspension due to wave stirring.*"

48. It is my opinion that because prevailing currents have been shown by the Port's instrumentation to be generally directed toward the east, sediment plume movements from the proposed offshore disposal site are generally directed offshore and away from Pania Reef. This is indicated by the results of the modelling. In contrast, due to the predominantly easterly currents, I would expect that should disposal of the dredge material take place at the inshore location, there would be a greater potential for sediment plume movements to be directed toward the sensitive receptor site at Pania Reef, thus resulting in a temporary increase in suspended sediment concentrations in the vicinity of Pania reef when compared with background levels.

49. The location of the proposed disposal ground is in deeper water than the inshore spoil ground (approximately 20 m depth for Site 5 and 10 m depth for the inshore disposal ground). In my opinion, the deeper water at the proposed disposal area results in less potential for resuspension of fine sediments due to wave-induced stirring than at the inshore spoil ground, as wave-induced near bed currents would be typically very low in 20 m depth when compared to those in 10 m depth or less.

50. For the reasons outlined in paragraphs 48. and **Error! Reference source not found.**. above, my opinion is that there would be less potential for an increase in suspended sediment concentrations at Pania Reef from disposal at the proposed disposal site than if disposal were to occur at the inshore spoil disposal area. Under the conservative scenario adopted for the dredge plume modelling, disposal at the proposed disposal site does not lead to any predicted increase in suspended sediment concentration above

background levels within the Pania Reef Significant Conservation Area.

51. I refer to the evidence presented separately by my colleague, Dr Ben Williams, who has undertaken an overfill ratio assessment of the dredged sediment compared with the native beach sediment, to assess the suitability of the dredged sediment for use as beach nourishment at Westshore. Ben Williams' assessment found that based on the known properties of the dredged sediment and native Westshore Beach sediment as determined using the grain size distributions of the available geotechnical data, an overfill ratio greater than 10 would be required which indicates that the dredged material would be unsuitable for use as beach nourishment.

52. In my experience as a coastal engineer, I am not aware of any established treatment process that can be applied to the dredged material in the hopper, to obtain material with a grain-size distribution that would meet the suitability criteria to allow it to be used as beach nourishment as proposed by Council staff in Condition 17 of the Draft Conditions of Consent CL180010E and CL180010E, and Condition 18 of the Draft Conditions of Consent CL180009E.

53. In summary, based on the above considerations, my opinion is that the Council staff's proposed condition to provide suitable material for beach nourishment at Westshore Beach cannot be met if dredged sediments are to be used for this purpose. This is based on the assessed effectiveness or suitability of the dredged material for this purpose and the lack of an established treatment process that can be applied to the dredged sediments to allow them to be considered suitable for beach nourishment.

Requirement for Water Quality Management Plan

54. I refer to Draft Conditions of Consent no. 9 and 10 of CL180009E and CL180010E which outline the requirement for a Water Quality Management Plan.

55. I note that Condition 10 (a) requires that validation of modelled predictions be included in the application documentation.

56. This requirement has now been met. Since the commissioning of the studies that form the basis of the Resource Consent Application, Advisian has validated the

results of the dredge plume modelling against field data that was collected over the course of two days during a maintenance dredging campaign that was undertaken in October – November 2017.

57. The dredge plume properties compared and the full extent of the validation is summarised earlier within this evidence.

RESPONSE TO MATTERS RAISED IN SUBMISSIONS

58. In this section of my evidence I respond to some of the comments and claims in the various submissions. As a number of submissions raise similar matters, I have grouped them and addressed them as issues.

Dredge Plume Modelling – Adequacy of Basis for Model

59. Legasea Hawke's Bay (Submission 25) states that "*dredge plume modelling is said to have been conducted off samples taken in a snapshot from 9/12/16 to 16/1/17. Recreational divers tell us that the current direction and velocity can vary throughout the year, thus questioning the results of the modelling. Further, current modelling based on hydrodynamic ADCP was taken primarily to the west of the channel, SW of Pania. We believe this is not a true reflection of current flow across the reef*". A similar comment is made by NZ Angling and Casting Association and Pania Surfcasting Club (Submission 40), and Aaron Duncan (Submission 7).

60. In relation to these concerns about the current sampling used for calibration and validation of the modelling, Napier Port is undertaking ongoing data collection. The modelling has been calibrated and validated against additional current sampling, including against two specific higher energy "events" – one calibration event between 18 May and 26 May 2016, and another in the second half of July 2016. In addition, the modelled currents have been validated at two additional sites, including at an ADCP near the proposed offshore disposal ground and near the navigation channel, for events between September 2017 and November 2017. The locations of the ADCP deployments are shown in Figure 3 and the results of the calibration and validation of the hydrodynamic model against measurements at these locations over various time periods are shown in Figure 4 to Figure 7. While the location of the ADCP measurements were not on the reef and the focus of the modelling was not to schematise the detailed

currents on the reef itself, the model validation against the ADCP data at multiple locations and multiple events provides confidence in the skill of the model to predict the current velocities and directions throughout the model domain. This provides confidence in the modelled currents in the vicinity of the reef.

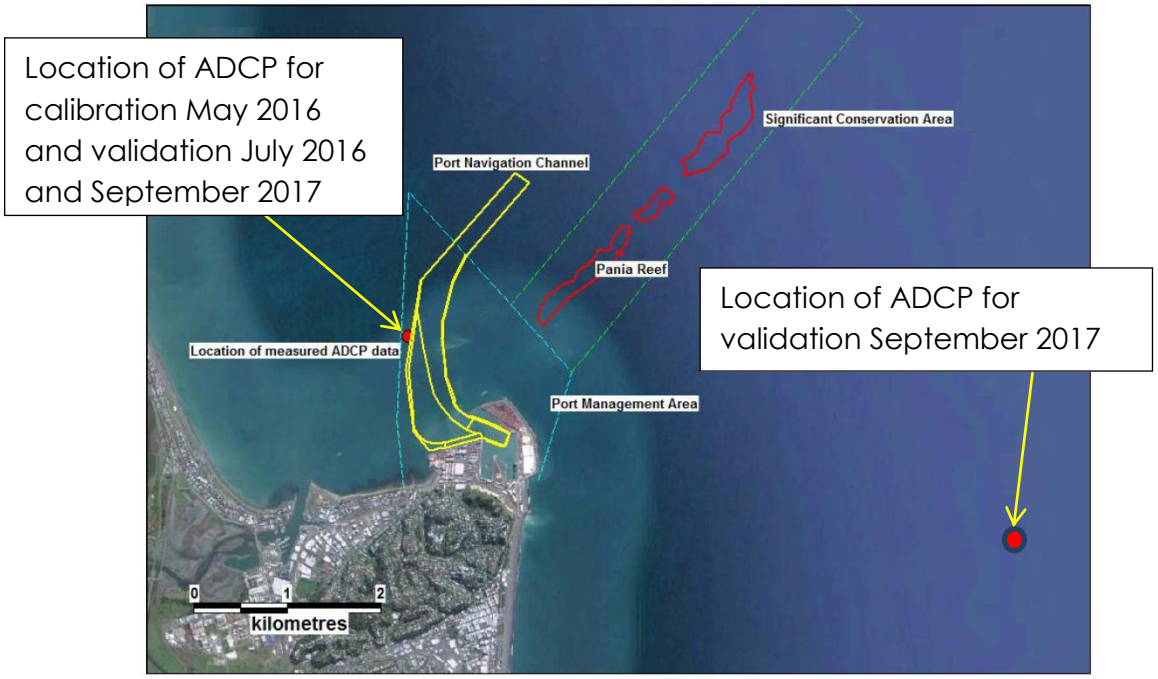

Figure 3 – Location of ADCP deployments for hydrodynamic model calibration and validation

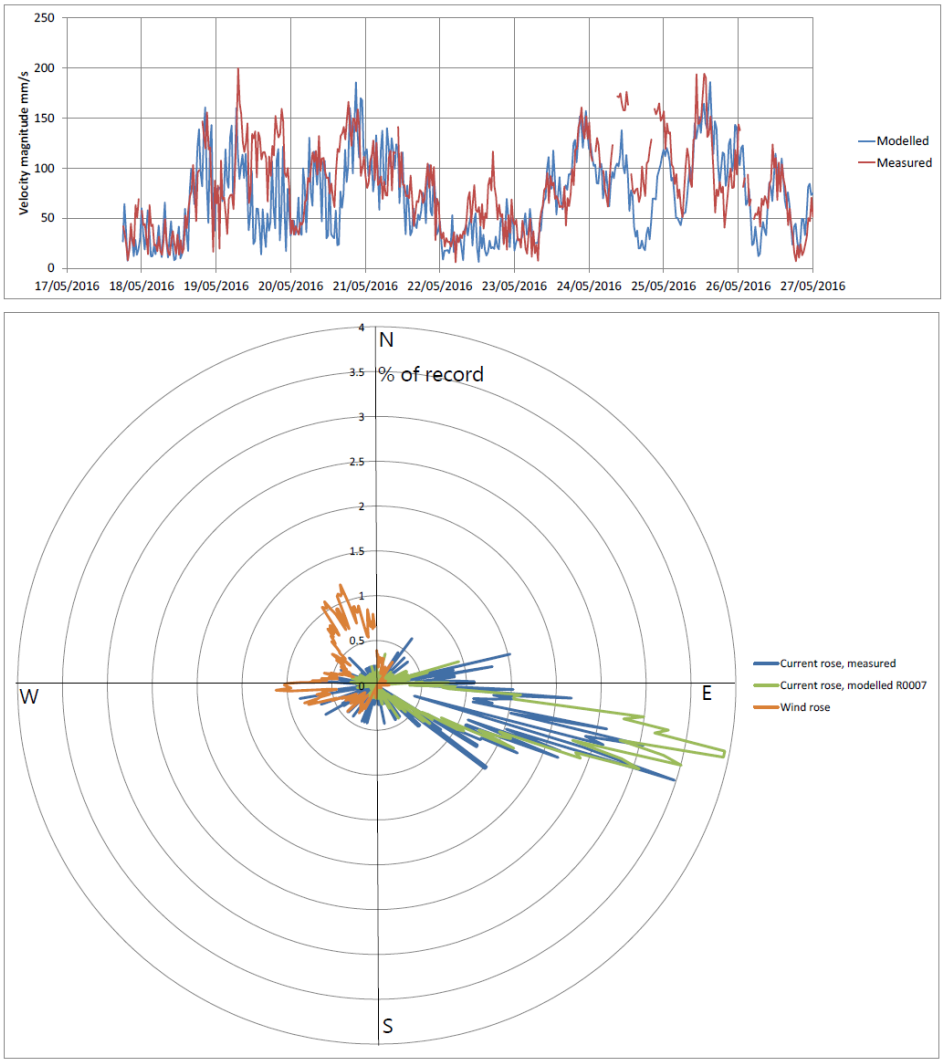

Figure 15 – Modelled vs. measured current directions and magnitude time series for calibration period (note – wind direction shown is direction from which the wind is coming; current direction is the direction to which the current is travelling)

Figure 4 – Comparison of modelled vs measured currents and directions at Channel approaches ADCP, May 2016

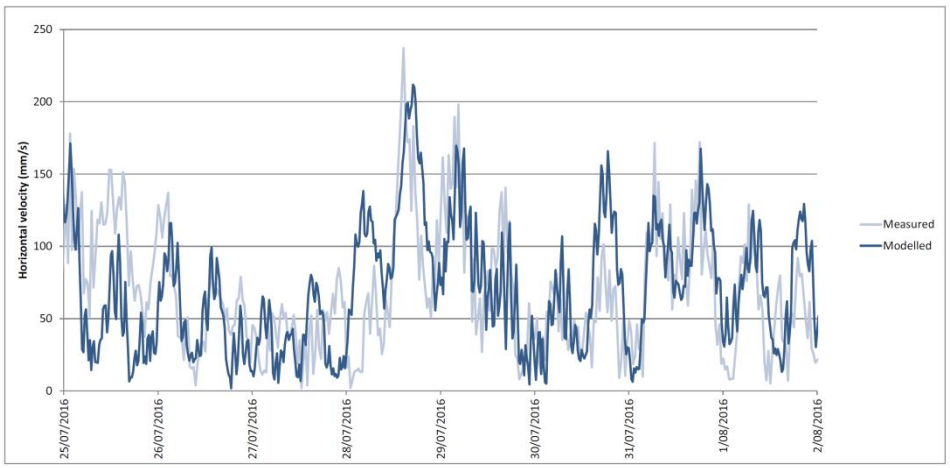

Figure 5 – Comparison of modelled vs measured currents at Channel approaches, July 2016

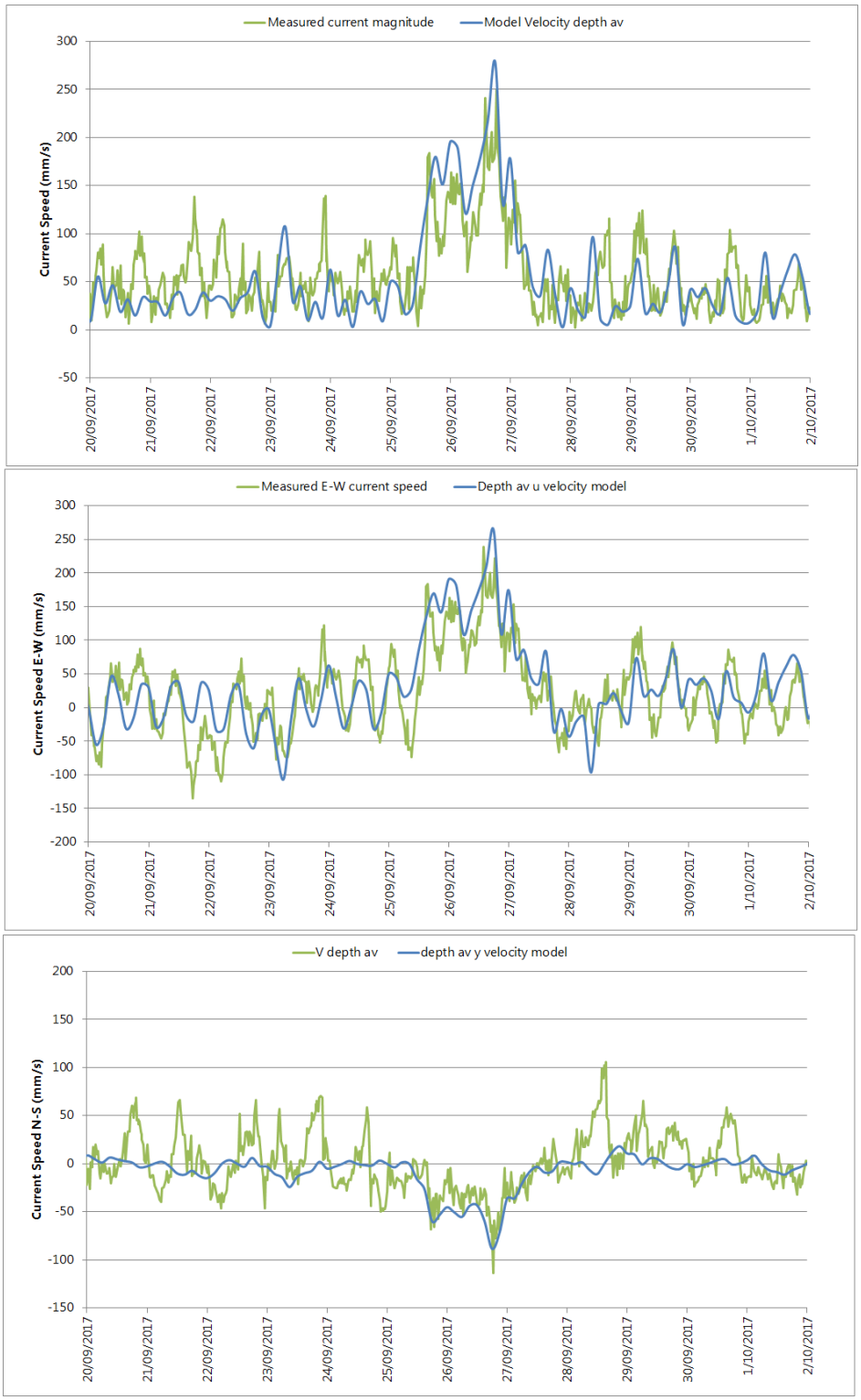

Figure 6 – Hydrodynamic model validation at channel approaches, September 2017

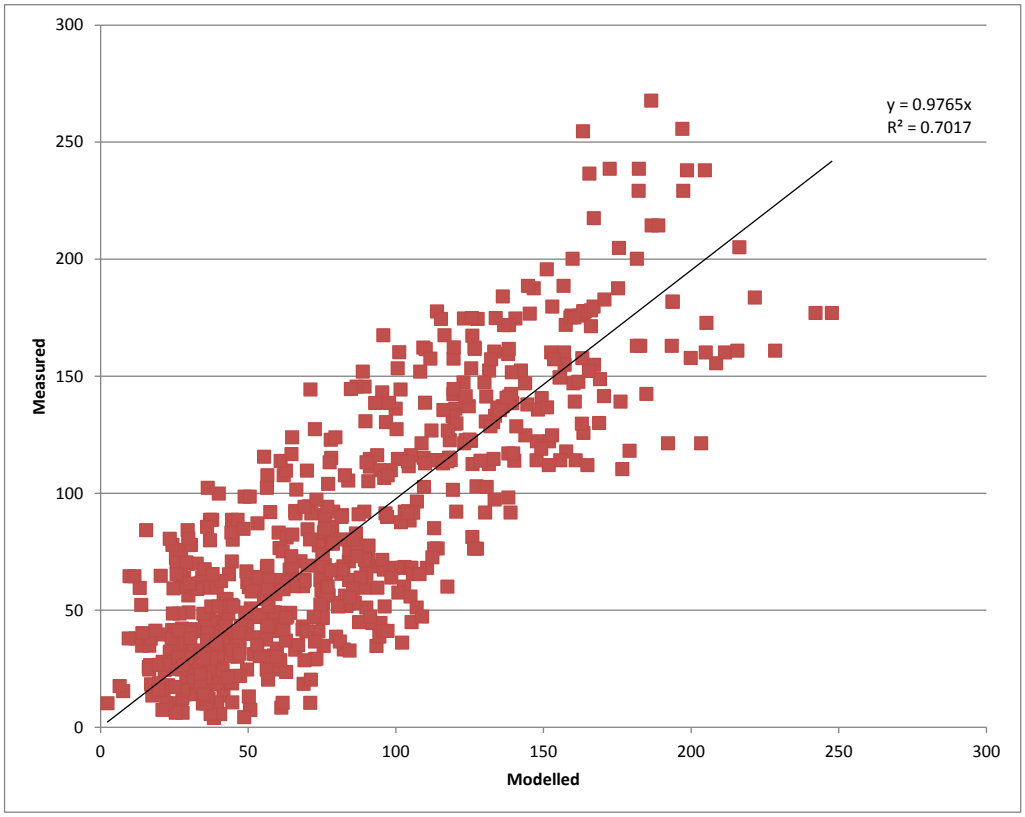

Figure 7 – Comparison of measured vs. modelled current velocity at offshore ADCP location, September 2017

61. As mentioned above, the focus of the modelling is not to schematise the currents at the reef in great detail but to provide an indication of the potential for currents from the dredge areas and disposal site to carry sediments toward the reef, hence the focus on collection of ADCP data at the offshore disposal ground and at the navigation channel.

62. Ongoing current measurements are being undertaken, which show that prevailing currents are predominately toward the south and east and these would carry the sediment away from Pania Reef. Ongoing ADCP current data at the proposed offshore disposal ground has been aggregated in Figure 8 across the following contiguous deployments:

- 8th Dec 2016 – 3rd Feb 2017
- 1st March 2017 – 1st June 2017
- 29th July 2017 – 18th Sept 2017

63. It can be seen from Figure 8 that the currents are predominantly toward the south, indicating that the fine

sediments whether during deposition, or in any later reworking, would be carried away from Pania Reef.

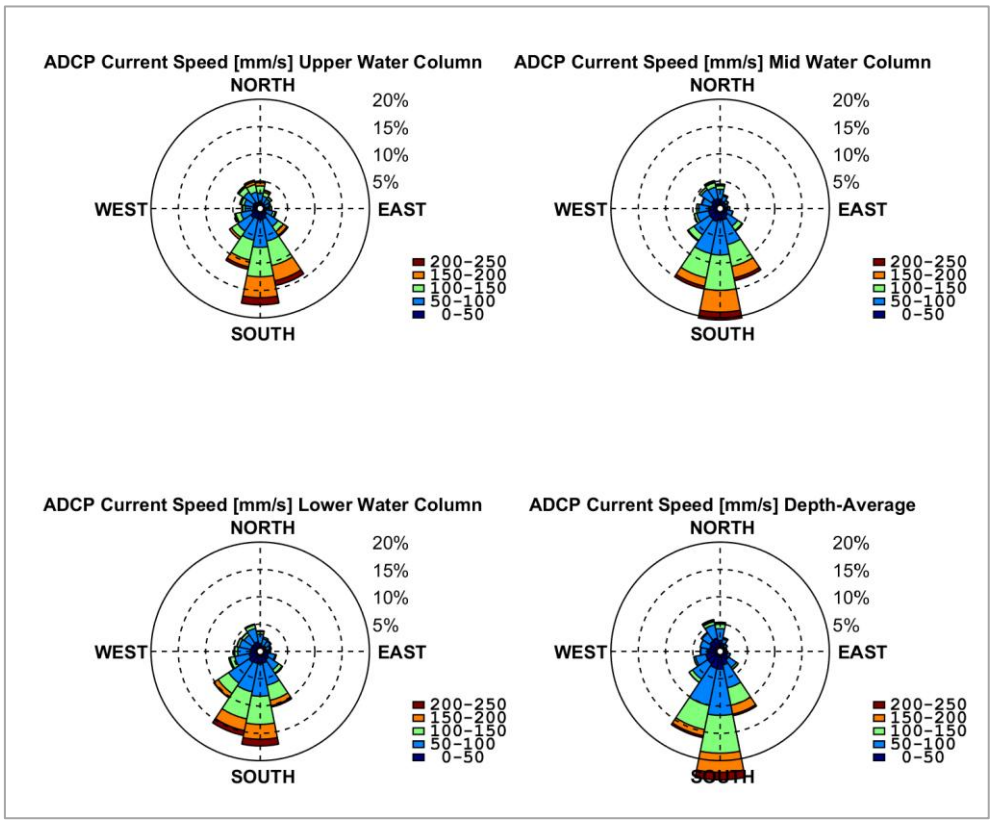

Figure 8 – Measured current directions at offshore spoil disposal ground based on ongoing ADCP deployments.

64. This has confirmed the modelling undertaken for the application, and its findings.

Disposal of Dredge Material Further Offshore

65. Legasea Hawke's Bay (Submission 25) Napier Fisherman's Association (Submission 21), Alex Jones (Submission 5), and NZ Angling and Casting Association Inc and Pania Surfcasting Club (Submission 40) all advocate that "*all dredge material, both capital and maintenance, be transported further offshore to the edge of the drop-off*". Legasea indicates this would be 37 nm east of PON at a depth of approximately 500 m and is on the basis that in that "*ocean currents would disperse the plume*". I have attached Figure 9, below which indicates where this could be.

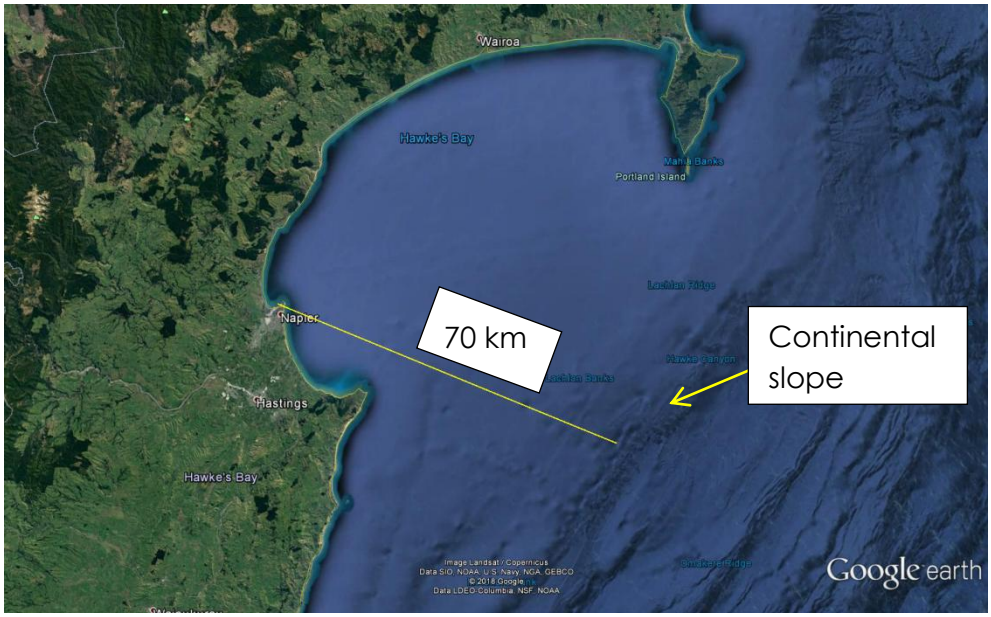

Figure 9 – Distance from Napier Port to edge of continental shelf, or "drop off"

66. The evidence of Mr de Vos addresses the additional time and cost involved in this suggestion and Dr Sneddon comments on this request in terms of potential ecological impacts.

67. In my opinion, dumping of dredged materials at a much greater distance and beyond the drop-off is not necessary for the following reasons:

- The proposed disposal area is in 20 m to 25 m water depth. The location of the proposed disposal area is in deeper water than the current inshore disposal area (approximately 10 m depth). The deeper water at the proposed disposal area means there is little potential for resuspension of fine sediments due to wave-induced stirring, as wave-induced near bed currents would be typically very low in 20 m depth.
- Deposition of material at the proposed disposal ground would increase the level of the seabed by only approximately 1 m and hence would not result in an increase in the potential for wave induced currents to resuspend material.
- There is very little current data available in the deep ocean area to verify any potential modelling of the impact of disposal of dredged material, or the post-dredge fate of sediments disposed in such areas.
- In the event that currents temporarily transport any sediment toward Pania Reef, wave breaking at the reef

as shown in Figure 10 would resuspend the sediment, and deposition onto the reef would not occur.

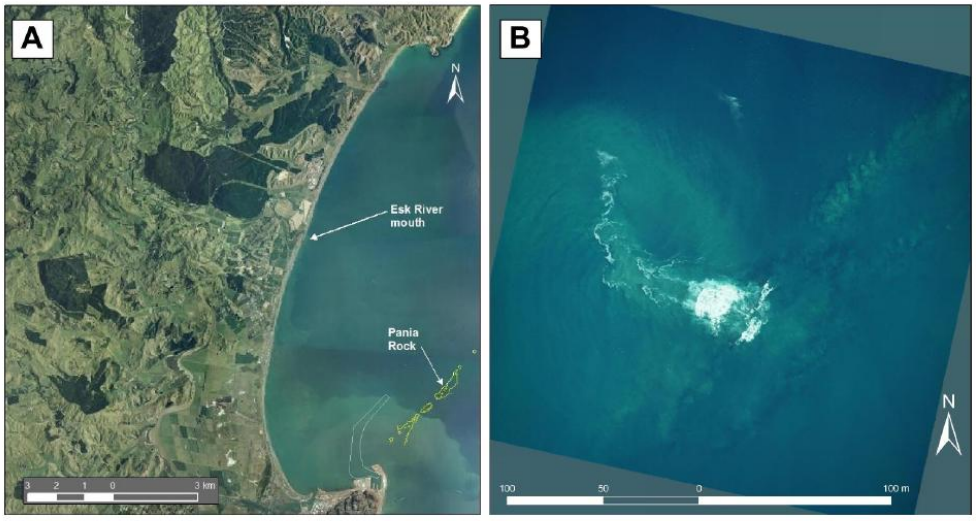

Figure 46. Aerial photographs of Napier coastal turbidity effects. A: Port and Westshore Beach area showing a turbid plume in the region of the Port. The position of Pania Reef and the outline of the proposed capital dredge area are overlain for reference (LINZ orthophoto taken 10 January 2004). B: Wave breaking on Pania Rock in heavy swell conditions (1040 hrs 24 March 2001: Tide = 0.35 m CD; H_s = 2.5 m; T_p = 13 sec; swell direction = 95°T; wind speed = 4 kts; wind direction ENE). Photo has been rotated to align with true north.

Figure 10 – Wave breaking on Pania Rock showing resuspension of sediments

Effects in and near to Ahuriri Estuary

68. The submission of the Mauri Protection Agency (Submission 26) raises a number of concerns about the potential adverse effects of the Project, including on:

- Tidal exchange within the Ahuriri Estuary
- Natural tidal movement within the Ahuriri, Westshore and Whirinaki areas.

69. In relation to tidal exchange within the Ahuriri Estuary, the proposed offshore disposal area will reduce any impact that the existing disposal at Site R would have on sedimentation within the Inlet, due to its location and the distance of the offshore disposal area from the estuary inlet. In addition, tidal currents from Ahuriri Inlet are expected to be very low and hence have a relatively minor influence on the current patterns in the Westshore areas (and areas further afield such as Whirinaki), due to the relatively low tidal prism of the inlet (i.e. with only a small volume of water in the inlet available for tidal exchange with Hawke Bay). The proposal

would not have any impact on these currents or the potential to entrain sediment into the estuary.

70. The channel deepening would have a minor impact on wave direction as described below[1]. The net direction of longshore transport between HDR02 and PB01 is eastward, as evidenced by the orientation of Port Beach and sand accumulating against the western edge of the groyne close to point HDR01 (see also Figure 11, below). The clockwise rotation of wave activity between PB01 and HDR02 will therefore reduce overall littoral transport, as the change in wave direction will reduce eastward transport rather than increase westward transport.

71. The net direction of littoral drift changes to westward somewhere between HDR02 and HDR03. Therefore between HDR03 and AI01 littoral drift would increase, although noting that the change in wave direction along this section of the beach is equal to or less than 1°. This rotation can only be realised if there is sufficient wave energy on the beach to drive morphological change.

72. The beach at the eastern mole of Ahuriri Inlet is in close alignment with the incident wave direction and would require a clockwise beach rotation of about 4 degrees before the MSL contour moved seaward of Ahuriri Inlet eastern training wall. That is, any adjustment of the beach is likely to be minor and contained within the bounds of the Ahuriri Inlet eastern training wall and the rubble shore at Spriggs Park. Hence, no impact on sedimentation within the Ahuriri Inlet would be expected as a result of the channel deepening.

[1] Appendix D, Figure 7-1 and Table 7-1 of the application.

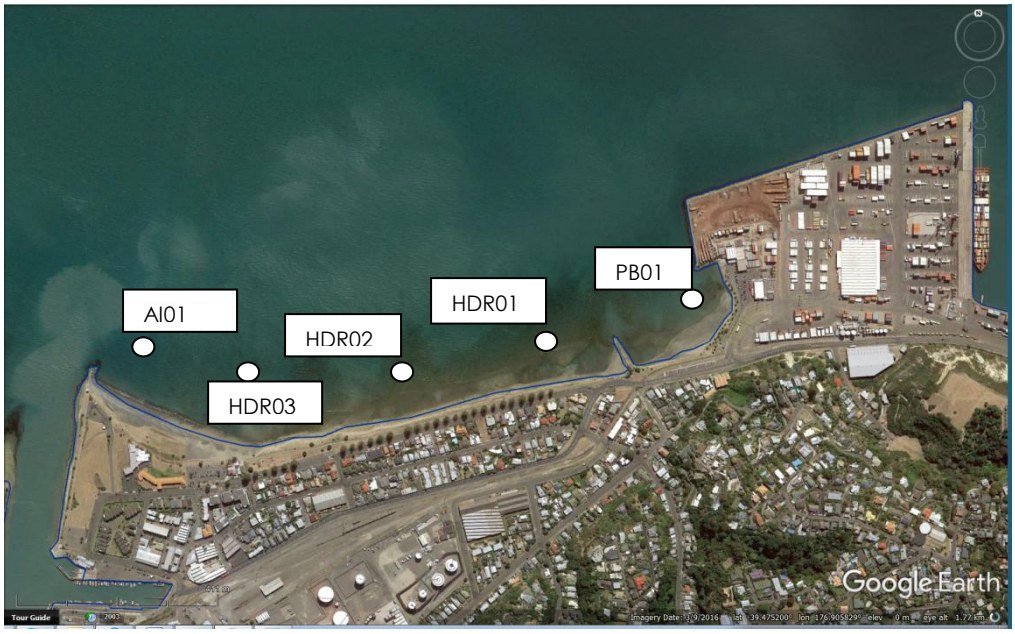

Figure 11: Beach alignment between Port Beach and Ahuriri Inlet showing locations referred to in the text.

73. Natural tidal movement within the Ahuriri, Westshore and Whirinaki areas would be unaffected by the proposal. Ongoing current data collection over many months has indicated that the currents are overwhelmingly wind-driven in this area. As noted earlier, the hydrodynamic models used for the sediment transport have been calibrated and validated against updated data. This has confirmed the reliability of the models and has provided further confidence in the original assessments of less than minor effects.

Adequacy of modelling in relation to potential cultural impacts

74. The submission of Ngaio Tiuka (Submission 30) raises concerns relating primarily to the dispersion of sediment disposal on the ecology and cultural values of Pania Reef and Town Reef, and questions the adequacy of the modelling undertaken, including the representativeness of the base conditions, and the duration of the simulation.

75. In relation to the above concerns, the modelling has considered the stormy period of July 2016 to be used as the basis of the water quality modelling, which provides a conservative assessment. It was selected for the following reasons:

- July 2016 included major wind events when compared to measured wind data between 2005 and 2015, including strong westerly winds

- However, a range of representative wind directions occurred over the month, including south-easterly winds which have the greatest potential to transport material toward Pania Reef

- Stormy periods have been shown by the preliminary dredge plume modelling to result in larger sediment plumes.

76. Thus, the selection of the stormy period of July 2016 can be considered to be a "worst case scenario" in relation to the potential spread and movement of the dredge plume and the potential for the plume to impact on Pania Reef. The one month simulation time is considered to be appropriate for the following reasons:

- The dredging will be carried out in a series of individual stages or "campaigns". For the Trailer Suction Hopper Dredging (TSHD), the length of these individual campaigns would likely not exceed 2 weeks. Thus the maximum effect of sedimentation during dredging and disposal is captured by the one-month model scenario which combines the effects of the TSHD with the backhoe dredging.

- The one-month simulation time captures the effects of a full monthly neap and spring tidal cycle.

77. Multiple sediment sources were introduced in the model to account for dredging from all the proposed areas as well as disposal over the full extent of the disposal area.

78. The modelling has been calibrated and validated against multiple current measurement locations and time periods as described earlier in this evidence.

79. It is appropriate to model the impact of the sedimentation from the Project only, so that this can be isolated from the background sedimentation that may be occurring as a result of outflow from rivers during flood events. Including the impact of sedimentation from the rivers would not enable the potential impact of the dredging project to be identified and quantified.

Impact on Surfing Amenity

80. The submission of Glenn Abel (Submission 31) raises concerns about potential impacts of the project on surfing amenity at Hardinge Road and City Reef.

81. The potential impacts on surfing amenity have been considered in detail[2] in accordance with the methods outlined in the scientific literature, including Hutt *et al* (2001), Mead (2003) and Lewis *et al* (2015). The classification of the surf breaks both before and after dredging was undertaken in accordance with these methods. In addition, the location of the surf break at City Reef was taken from that assessed by MetOcean Solutions (2009), which recorded surf break locations and surfing paths using GPS tracking of surf riders.

82. There is a high degree of confidence in the modelled wave directions and wave heights, as the wave modelling has been subject to detailed calibration and validation. The wave models were validated against two separate storm events and at three discrete locations – including at Beacons, East Pier and Hardinge Road. These sites capture the refraction of waves around the Port as well as the effects of the existing navigation channel. The quality of the calibration and validation is illustrated in Figure 12, below.

83. The Surfbreak Protection Society have undertaken a peer review of the studies and have stated in their submission[3] c/- Michael Gunson) that "*Port Napier has provided 10 years' worth of baseline data that has provided sufficient information to our own peer reviewers that adverse effects on the four listed surf breaks are unlikely*".

[2] See Appendix D of application documentation, Section 6.

[3] Refer Submission 38 Surfbreak Protection Society.

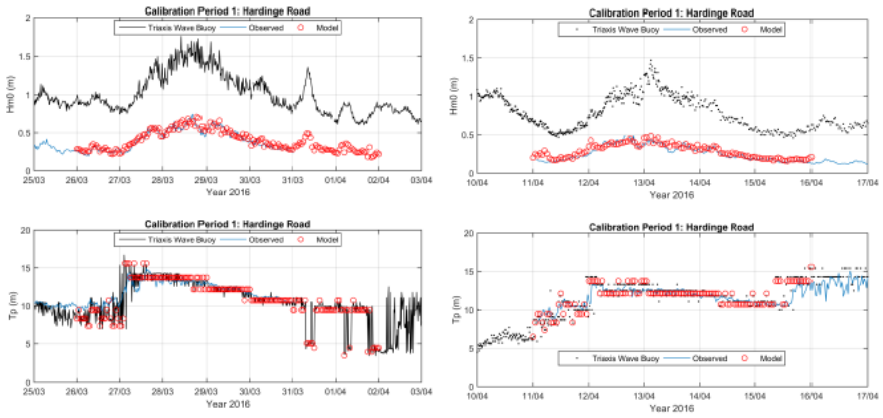

Figure 4-8: Comparison of calibrated wave model against storms 'Cal1' and 'Cal2'. Calibration site 'Hardinge Road'.

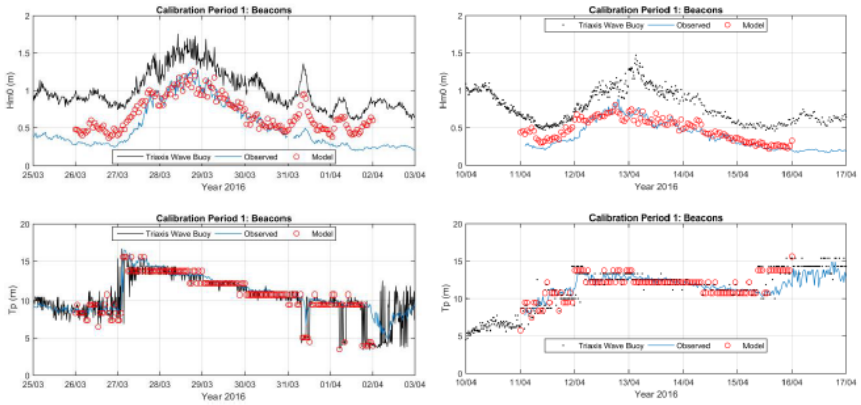

Figure 4-6: Comparison of calibrated wave model against storms 'Cal1' and 'Cal2'. Calibration site 'Beacons'.

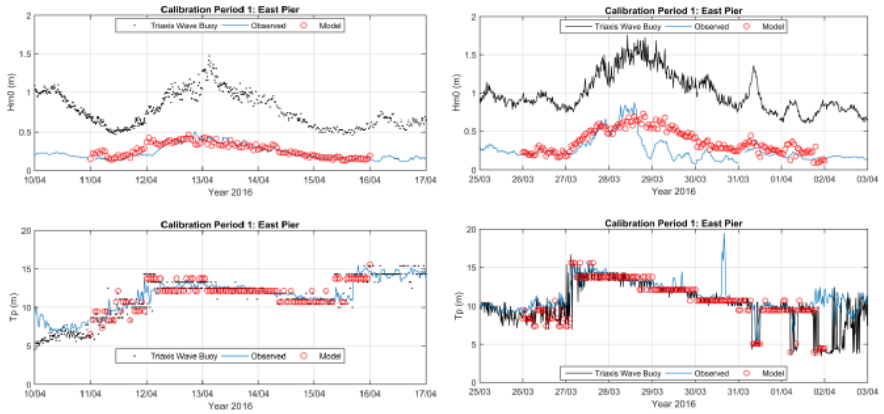

Figure 4-7: Comparison of calibrated wave model against storms 'Cal1' and 'Cal2'. Calibration site 'East Pier'.

Figure 12 – Calibration of wave model at three different locations and over two different storm events.

84. The study used ten years of actual recorded wave data, transformed using the validated and calibrated model, which has been demonstrated to be accurate over multiple storm events and at multiple locations, including at Hardinge Road. Many storm events have been captured in this data and there is a high degree of confidence in the findings. The model can therefore be used with a high degree of confidence to capture any impact of changes in wave refraction patterns (and hence changes in wave height and direction) and thus any changes in surfability as a result of the dredging at the swing basin.

85. Over time, minor changes in depth within the swing basin due to subsequent sedimentation infilling (between maintenance dredging periods) will not affect wave refraction patterns. It is the discontinuity between the swing basin and surrounding ambient bathymetry levels that impacts on wave refraction and this will not change significantly over time after the capital dredging is complete, and is fully captured by the modelling. The design of the geometry of the swing basin and channel went through a process of optimisation during the early stages of project planning, in order to minimise the potential for any impact on wave climate in the lee of the channel.

CONCLUSIONS AND RECOMMENDATIONS

86. Based on the outcome of the calibration and validation of the various numerical models used to assess the dredge plume dispersion against measured field data, and the extent of available data used to assess the effects of the project, I consider that the dredge plume modelling presented in Appendix E of the Resource Consent Application is sound and in accordance with industry best practice. I consider also that the results of the modelling can be relied upon for assessing the spatial impact of the proposed dredging on suspended sediment concentrations above background levels during the dredge campaigns.

87. Based on the surfing amenity assessment that I have documented in Chapter 6 of Appendix D of the Resource Consent documentation, I conclude that the proposed dredging would have little impact on the surfing amenity at the surf breaks at City Reef and Hardinge Road.

88. Due to the direction of prevailing currents as obtained from long term field measurements undertaken by the Port, and

the shallower depth at the inshore disposal ground when compared with the offshore disposal area, my opinion is that there would be greater potential for a temporary increase in suspended sediment concentrations at Pania Reef if disposal were to occur at the inshore spoil disposal area as opposed to the offshore disposal area.

89. In my experience as a coastal engineer, I am not aware of any established treatment process that can be applied to the dredged material, to obtain material with a grain-size distribution that would meet the suitability criteria to allow it to be used as beach nourishment as proposed in Condition 17 of the Draft Conditions of Consent CL180010E and CL180010E, and Condition 18 of the Draft Conditions of Consent CL180009E.

90. My opinion is, therefore, that the proposed Council staff Condition of Consent requiring provision of suitable material for beach nourishment at Westshore Beach cannot be met if dredged sediments are to be used for this purpose. This is based on the assessed effectiveness or suitability of the dredged material for this purpose and the lack of a known treatment process that can be applied to the dredged sediments to allow them to be considered suitable for beach nourishment.

Christopher Alexander Adamantidis

6 August 2018