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 area for existing port activities and the proposed new wharf

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STATEMENT OF EVIDENCE OF MARTIN BERNARD SINGLE

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INTRODUCTION

Qualifications and experience

1 My full name is Martin Bernard Single.

2 I am an environmental consultant with over 25 years of experience. I hold a Ph.D. in Geography, the topic of which investigates coastal processes and geomorphological change. I am a director and principal consultant for Shore Processes and Management Limited, specialising in the science, management and planning of coastal lands and waters. I am an associate member of the Institute of Professional Engineers of New Zealand, a member of the International Coastal Navigation Association PIANC, and a member of the New Zealand Coastal Society. I also hold a position as a Senior Fellow in the Geography Department, University of Canterbury.

3 I have authored or co-authored over 250 reports dealing with coastal geomorphology and management in New Zealand, Scotland and Fiji, including hazard assessment and mitigation measures, nearshore, beach and estuarine sediment transport, dredge spoil dispersal, beach nourishment, beach management prescriptions, and planning and audit control of consents for coastal protection structures and lake shoreline change.

4 My areas of specialisation are coastal processes and coastal management of New Zealand ocean beaches, lakeshores and harbours.

5 My work on harbours and sedimentation has included physical coastal process studies and assessment, beach management, nearshore and beach sediment transport, coastal hazard assessment, and where necessary the development of management and monitoring prescriptions. Of particular relevance for the Port of Napier consent, I have carried out work for:

(a) Port Otago Limited (POL), providing expert advice on physical coastal processes for maintenance and capital dredging consents, including the current capital dredging consent issued in 2012 for deepening of the harbour channel;

(b) POL wider coastal sedimentation and beach management studies of Otago Harbour and Blueskin Bay, including beach management at Te Rauone Beach and Shelly Beach;

(c) Bay of Plenty Regional Council, on sedimentation and the navigability of Kaituna River mouth;

(d) Tranz Rail Limited, on sedimentation and shore management at Clifford Bay and vessel wake effect in Marlborough Sounds;

(e) Beca Infrastructure, reviewing sedimentation aspects of dredging for Ports of Auckland; and

(f) Port of Napier (PON) reviewing coastal literature and interpreting coastal change for the coast in the Napier area, and reviewed coastal process modelling in relation to potential port developments in the mid-2000s.

6 I have technical expertise in the working of the mixed sand and gravel beaches such as make up the Napier shore, with my Masters thesis in Geography investigating the response of the Napier beaches to the uplift resulting from the 1931 earthquake, and my PhD thesis investigating the geomorphological response of mixed sand and gravel beaches of South Canterbury to high energy waves.

7 I also grew up in Napier and am familiar with the Napier coastal environment through recreational use in the 1960s and 70s.

Involvement in project

8 My role with this project was to provide an overview of the physical coastal processes of the Napier area, and to advise on issues of coastal management relevant to the potential effects of the project. In addition, I have assessed and provided a lay interpretation of the technical modelling of coastal processes relating to waves, currents and sediment transport.

9 I have provided information for PON in the past with regard to the physical coastal processes and the nature of historical changes to the coastal geomorphology. In the early to mid 2000s, I reviewed modelling of the effects of wharf extensions and reconfiguration.

10 I was also involved in expert caucusing that took place on 20 July 2018.

Expert Witness Code of Conduct

11 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

12 In my evidence, I present an overview of the physical coastal environment in the vicinity of the Port of Napier and provide comment on the effects of the proposed capital dredging of the central fairway, outer swing basin and inner swing basin at the Port, and the effects of disposal of dredge spoil offshore of the Napier coast.

13 The effects of dredging and dredge spoil disposal on the physical coastal processes and the wider coastal environment were identified through reference and interpretation of detailed technical studies that involved field observation, measurement and data collection, and numerical and empirical modelling. The technical reports by Advisian and the evidence of Chris Adamantidis and Ben Williams cover that work.

14 As such my evidence covers the following topics:

(a) A description of the physical coastal environment of the Napier coast, including the coastal geomorphology, the existing wave and current processes and the sediment transport patterns;

(b) A summary of the changes to the coastal processes and physical coastal environment as a result of the proposed dredging and disposal of sediments;

(c) A summary of the potential effects of changes to the wave environment on the wave corridor inshore of the deeper channel and on the beaches west of the port, and to the area inshore of the proposed disposal site and the beaches of Marine Parade;

(d) An assessment of the effects of the proposed dredging operation and placement of dredged sediment on the sedimentation processes of the Napier coast. These effects include turbidity from dredging, at the dredged sediment placement site and areas in-between, and changes to wave refraction and sediment movement on the seabed as a result of placement of dredged sediment;

(e) Comments in response to matters in the Section 42A report and matters raised by submitters.

Summary of conclusions

15 The coastal area around Napier is characterised by the nature of the sediments making up the coast, and the limited nature of the wave environment in Hawke Bay. The mixed sand and gravel sediments of the beaches result in two distinct sediment transport systems, with coarser sediments (sand, gravel and cobbles) moving on the beach due to wave action, and fine sediments (fine sand, and silts) moving on the seabed due to wave and wind-driven currents.

16 The studies carried out on the proposal to deepen the navigation channel, and to deepen and increase the size of the swing basin at the port included investigations on the material to be dredged, the effect of the deeper channel on the wave environment and the potential for movement of sediment on the seabed. The effects of dredging and dredge spoil disposal on the physical coastal processes and the wider coastal environment were identified through reference and interpretation of the detailed technical studies that involved field observation, measurement and data collection, and numerical and empirical modelling.

17 The main considerations for the potential effects on the physical coastal processes were:

(a) Potential changes to the wave environment as a result of deepening the entrance channel and disposal of sediment;

(b) Changes to patterns of sedimentation in the wider coastal area; and

(c) The dispersal of fine sediments due to the dredging and disposal operation.

18 The studies have shown that the effects are mostly small, and of magnitudes within the variability of the natural environment.

19 I consider that the conditions as proposed by the Port in Section 26.3 of the AEE appropriately provide for the anticipated effects of the proposed dredging and disposal on the physical coastal environment, and would lead to the identification and provide for mitigation of any unanticipated effects.

THE PHYSICAL COASTAL ENVIRONMENT OF THE NAPIER COAST

Background

20 A broad range of work exists regarding the physical coastal environment around Napier. Recent findings from investigations carried out for the Port have added to the background information in relation to aspects of the assessment of the effects of the proposed dredging and dredge spoil disposal.

21 The Port's proposal is to deepen and widen the existing approach channel to accommodate deeper draft and wider ships, and to establish a new berth (No. 6Wharf) on the northern face of the main port reclamation. The dredging work will involve widening the current dredged channel, extending it seaward by about 1.3 km, and deepening it in stages to a depth of 14.5 m below chart datum. The project will result in the dredging and disposal of approximately 3.2 million m^3 of material. It is proposed that the dredge spoil will be deposited in a new 342 ha disposal area located approximately 3.3 km southeast of Pania Reef, approximately 5 km offshore of Town reef in water depths of about 20 to 23 m.

22 A number of studies were carried out to augment the existing knowledge base of the coastal environment and to investigate specific aspects of coastal processes in the area. This work included studies on:

(a) *Hydrodynamic factors in the vicinity of the harbour and along the wave corridor landward of the shipping channel*

Measurements of waves and currents offshore of the channel, inshore off Westshore and the Beacons, and offshore of Marine Parade were carried out to assess the wider coastal environment.

Empirical and numerical modelling of the currents and wave processes was carried out by Advisian to assess the wider coastal environment for plume dispersal and receiving dredged material.

Advisian also assessed the wave environment in the vicinity of the channel to identify changes to the wave propagation across the deeper channel and into the nearshore and beaches. The results are presented in the evidence of Chris Adamantidis and Ben Williams.

(b) *Sediment characteristics of material to be dredged from the channel and within areas to be dredged*

Beca Ltd carried out an investigation of the geotechnical aspects of the seabed to identify the types and quantities of different sediments that would be dredged in deepening the channel and the swing basins.

(c) *Sedimentological factors of potential dredge spoil receiving sites, including sediment characteristics of the nearshore and adjacent beaches*

Beca Ltd and the Port carried out measurements of nearshore seabed and beach sediments to determine the sizes and mixtures of sediments at potential dredge spoil receiving areas and to examine the potential for beach nourishment at Westshore.

23 The work on the physical coastal environment was carried out in conjunction with work on ecological matters. Ross Sneddon presents a detailed assessment of the effects of the project on benthic ecology and fisheries in his evidence.

Regional coastal character

24 The beaches of Napier exhibit the complex nature of the wider coastal environment and comprise a mixture of sand and gravel.

25 The 1931 Hawke's Bay earthquake resulted in major changes to the character of the Westshore shoreline. The active beach at Westshore changed in form from a narrow gravel spit to a broader barrier with a wide sandy expanse on the seaward side. The seabed offshore of Westshore and Napier was raised, resulting in a coastal geomorphology in disequilibrium with the process environment. The elevation and width of the beach along the Marine Parade also increased due to the earthquake uplift.

26 The alignment of the beaches is generally north to south, facing east. Due to refraction within the bay, waves approach the shore from the east to east-southeast, and the beaches are generally aligned to the predominant wave approach.

27 In the context of coastal change, the mixed sand and gravel beach south of the port towards Awatoto (the Marine Parade) is stable to slightly accretional. The shore immediately to the west of the port contains small pocket beaches, with a sandy beach adjacent to the port, and a mixed sand and gravel beach built out against the east pier of Ahuriri Lagoon inlet. The shore along Westshore, north of Ahuriri Lagoon inlet, is erosional and has changed in character since the 1931 uplift, from a mainly sandy shore up until the late 1970s - early 1980s, to an artificially nourished mixed sand and gravel shore as a result of erosion and retreat of the shoreline and management measures undertaken to address the erosion.

Local Geology

Recent tectonic history

28 Figure 2.3 of my report at Volume 3, Appendix G, illustrates the varied tectonic response along the coast as a result of the earthquake. The stretch of coast south of Awatoto towards Cape Kidnappers dropped by up to 0.7 metres. The subsidence along this stretch of shore is an important factor in contemporary erosion, effectively due to the relative rise in sea level against the shore topography.

29 Uplift of the Napier beaches was thought to be about 0.6 to 1.5 m along Marine Parade, and 1.8 to 2.0 m along Westshore. The immediate effects of the uplift included raised elevations of the beach ridge along Westshore, and an increase in the width of the beach at Westshore and along the Marine Parade. The increase in elevation and beach width along this stretch of shore now provides protection for the city from storm waves.

Seabed sediments

30 Five main groups of sediments are evident over the wider Hawke Bay area. Extending mainly in bands from shallow to deeper water, these are:

(a) Offshore sand belt (particle sizes 0.06 to 0.25 mm);

(b) Offshore gravel zones (at depths of 18 to 30 m);

(c) Mud belt;

(d) Central zone (of pebbly muddy sand and muddy gravel); and

(e) Sediments associated with the Lachlan Ridge.

31 The sediments associated with the nearshore (shallower than 5 to 10 metres water depth), the port channel, and the Napier beaches are described later in my evidence.

Process environment

Waves

32 Waves provide energy to do work in generating sediment transport on the seabed. In water deeper than about 15 to 16 m, wave energy and the motion of water particles under the wave can act to disturb sediment particles on the seabed, initiating movement that results in entrainment of the particle by a combination of wave, tidal and oceanic currents. In shallower water, incident waves play a very important role in short and long-term beach stability, beach form and evolution, and have a direct effect on nearshore processes that include sediment transport.

33 In the nearshore, at a depth less than about 10 m, the energy of shoaling and breaking waves govern patterns of sediment transport to a considerably greater degree than tides and oceanic currents. In Napier, the shape of the waves inshore of the port channel provide for recreation through surfing at Hardinge Road and along the Westshore coast.

Wave environment off Napier

34 Wave data at Napier has been collected over various periods, including by the Ministry of Works from 1975 to 1980, and the Port in 2000 and from 2004. Additional wave data was collected for this project since April 2016. Advisian have used the wave data record (from 2004 to 2016) in calibrating wave models for assessment of the effects of the proposed dredging and disposal.

35 The majority of waves approach Hawke Bay from the southeast. However these waves are refracted within the bay so that the approach to the shore is from the east to east-southeast. Average significant wave heights (Hs) range from 0.1 to 3.5 metres, with 50% of all waves between 0.5 and 1.0 m. The general conditions from the 1975 to 1980 data were found to be consistent with analysis of data from the Port wave buoy.

36 Analysis of the wave data by Worley Parsons and Advisian show that highest wave conditions occur generally during winter (July and August), when the Hs is in the order of 1.5 m.

Ocean and Tidal Currents

37 There are three types of water currents in Hawke Bay. These are ocean currents, tidal currents and wave-induced currents. Flows from ocean currents have little effect on nearshore sediment movement. The tidal currents can cause offshore movement of suspended sediment, and can carry sediments out into the bay.

38 Numerical modelling strongly suggests the presence of a persistent anticyclonic gyre immediately northwest of the Port breakwater under strong winds from the southwest. During westerly and northwesterly winds, currents are directed in a southeasterly direction along the coast.

39 These broad-scale currents are very low velocity, and are unlikely to result in sediment transport in isolation of other forcing energy. However they can work in combination with wave activity that induces sediment movement through suspension and unequal distribution of energy along the shore to contribute to sediment circulation patterns.

40 Dr Ben Williams will present detailed analysis of current flows as derived from measurements off Napier.

Bathymetry

41 Figures 2.9 and 2.10 of my report (Volume 3, Appendix G) show the bathymetry of the area offshore of Napier. The port channel (dredged to about 12.4 m depth) is about 2.0 km long, heading northwest and then north from the port.

42 Pania and Town Reefs are located to the northeast and south of the port respectively. The shallowest parts of Pania Reef lie at a depth of about 8 to 10 m, with the surrounding seabed extending from a depth of about 14 m to a depth of about 18 m. Town Reef projects from the seabed within the 10 m depth contour, with the highest points on the reef about 4.5 m below chart datum.

43 The Port proposes to locate the dredged sediment placement site for this project centred approximately 5 km offshore, east of the Marine Parade, and approximately 3.55 km southeast of Pania Reef, in approximately 20 to 23 m of water.

Beach sediment characteristics

44 The beaches to the south and north of the port are comprised of a mixture of sand and gravel, derived from greywacke eroded from the mountains and transported to the coast mainly as bedload. This type of beach is different from 'pure' sand or 'pure' gravel beaches in form and response to wave action.

45 A particular aspect of mixed sand and gravel beach processes is the across-shore zonation of sediment sizes, and the separation of the coarser component from fine sediments by a steep break in beach slope between the beach and the nearshore seabed. The crest and backshore of the barrier beach, as found at Marine Parade, is made up of coarse gravels and large disc-shaped pebbles. The lower foreshore contains sediments of all sizes, and they are usually well-sorted, so that pebbles, gravels and sand can often be seen to be separated out in bands running along the beach.

46 On the Marine Parade, there is a distinct separation of transport of sediments, with coarser particles moving on the beach face and immediately under the breaking wave, and fine particles (fine sand and silts) moving offshore and along the shore on the seabed and in suspension.

47 There is a much larger proportion of sand and fine sediments in the sediment mix at the Westshore beaches. This leads to a wider lower foreshore and a more gradual transition from the beach to the nearshore. Sediment transport of coarse sand along the shore occurs within the surf zone. Gravels usually only move within the swash on the upper beach.

48 The beach at East Pier is similar in character to the mixed sand and gravel beaches of Westshore and Marine Parade. Sediment movement along the shore occurs mainly in the nearshore.

49 The Port collected samples from the low tide level and the position of mean high water on the beach at 15 locations between the Port Beach and Esk River in January 2016. The mixed sediments at the across-shore locations can be classified as fine gravel, ranging in size from medium sand to coarse gravel.

Nearshore sediment characteristics

50 Data from previous studies by Hume *et al.* (1989) and Mead *et al.* (2001) was combined with grab samples collected by the Port and Cawthron to determine the spatial distribution of sediment grain size.

51 Mead *et al.* (2001) found for 100 grab samples, that the median grain size for sandy sediments was in the range of 0.11 to 0.31 mm, with an average of 0.15 mm. This is predominantly very fine, to fine sand. Coarser sand sized sediments are found within 2 to 5 m water depth and are more dominant along the northern section of Westshore. The band of coarser sand (over 0.25 mm in diameter) is confined to a generally narrow band near the shore. It is a by-product of the sedimentary geology and the process environment. Coarser greywacke particles (pebbles and gravel) abrade under wave and swash action and the sediment particles wear down

and get smaller. The abrasion results in a “source area” effect. The coarse sand will remain near to where it is produced. At Westshore, artificial nourishment of the beach introduces gravel and pebbles to the wave environment. These particles abrade and produce a source of sand sized particles that are transported north. Sand sized particles are also transported south along the shore from the Esk River and Bay View. This is the likely cause of the extended area of medium to coarse sand found in the area of The Gap and the Beacons.

52 A further sorting process occurs perpendicular to the shore. Larger particles require more energy to move, so the coarse sand is predominantly located in areas of relatively higher energy such as within the surf zone or near the shore, while finer particles are dominant further offshore.

53 Beca carried out core sampling within the port channel and harbour area. The sediment within the existing navigation channel, and the proposed dredge footprint is predominantly very fine, to fine sand. In summary, the surface and near-surface samples show:

(a) Approximately 20% of sediments are finer than 0.1 mm (very fine sand);

(b) Approximately 70% of sediments are sized between 0.1 mm and 0.2 mm (very fine to fine sand);

(c) Approximately 10% of sediments are coarser than 0.2 mm, 5% coarser than 0.3 mm and 1% coarser than 0.5 mm (fine to medium sand);

(d) The median (D50) particle diameter is approximately 0.125 mm.

Sediment transport paths

54 Rates of sediment transport are difficult to predict, so numerical modelling is undertaken using input data on the sediment properties, and derived transport capacity by currents based on wind, wave and current measurements in the field. Sediment transport modelling results show the **potential** for sediment to move due to the size of sediment in the environment and the energy vectors (magnitude and direction) relating to wave action and wave, wind and tidal currents. The amount or volume of sediment transported will depend on the amount of sediment of different sizes being ‘available’ for transport by the energy processes.

55 Figures 2.13 and 2.14 of my report show inferred pathways of sediment transport on the beach and in the nearshore off Napier. In summary:

(a) Mixed sand and gravel is moved on the beach in the swash zone, resulting in abrasion and contributing medium and finer sand, and silt particles that are dispersed to deeper water. This occurs at all sites where these mobile sediments are present, including artificial nourishment sediments at Westshore, and the mixed sand and gravel beaches.

(b) South of the port, beach sediment transport can occur in both north and south directions, with waves often not fully refracted when breaking.

(c) From Ahuriri inlet to Bay View there is a net northward transport of sediment on the beach and under wave action in the littoral zone.

(d) Along Hardinge Road, beach sediment transport occurs to the west at East Pier, and to the east at Port Beach.

(e) Fine sediments (smaller than 0.3 to 0.25 mm in diameter) are generally transported in suspension by wind-driven currents to the south during westerly and northwest winds, and to the north during southwest and infrequent southeast winds.

56 The long-term movement of sediment along the beach south of the port is from south to north. However abrasion of gravel by wave and swash action results in local generation of sand and silt particles that are removed from the beach to offshore by storm waves and return currents from the beach face. Annual net accumulation of gravel at the northern end of Marine Parade beach is relatively small.

57 At Westshore, beach sediment movement also occurs under wave action. The angle of wave approach at Westshore is a strong factor in determining the direction of sediment transport along the shore. Waves also result in sorting of (mainly) sand based on size. Coarser sediment is transported onshore by waves while finer sediment moves offshore.

58 For mixed sand and gravel beach systems, current induced movement of sediment on the seabed and within the water column can be distinct from transport on the beach due to waves. At Napier, wave induced currents during storms will move sediment on the beach and offshore. However during less energetic wave conditions, wave currents may initiate sediment entrainment, but wind and tide driven currents control the direction of transport.

59 Data from measurements of currents at three sites off Napier (the Beacons, adjacent to the navigation channel and off Marine Parade), along with measured wind data and sediment characteristics, were used as input data to run the numerical models of sediment transport for the area.

60 A significant finding from the model is the importance of wind in driving the currents that result in transport of fine sediments in depths of 2 to 10 m. Medium and coarse sand will be removed from the shore and move offshore during storms, but can move onshore during calmer conditions, and will be dispersed along the shore by beach transport and littoral currents within the surf zone. Fine sand and silt, suspended by wave action, is transported by the wind driven currents.

61 Sediment samples taken from or in the close vicinity of the navigation channel are consistent with the pattern of sediment transport. There is a small percentage of coarse sand at the distal end of the breakwater, indicative of bedload transport of sand particles under wave current processes, but most of the sediment is fine sand or smaller.

Human Activities

62 Construction of the Port's breakwater was undertaken in 1887-90. The breakwater has been lengthened over time to meet the needs of increased Port functionality. Analysis of wave refraction by Worley Infrastructure Ltd in 2002 found that wave heights were reduced by approximately half at Westshore beach due to the sheltering effect of the breakwater.

63 Komar's analysis of the coastal evolution at Napier addressed local concerns that the port breakwater was a cause of erosion at Westshore due to obstruction of the supply of sand and gravel from south of the port. It was found that although more than a century has passed since its completion, the beach updrift of the breakwater (the town beach at Marine Parade) had not built out to such an extent that gravel was moving along the face of the breakwater and entering the navigation channel. Dredging records and the analysis of sediment particles from the channel and harbour entrance show that predominantly fine sand from the nearshore and offshore seabed reaches that channel, rather than coarse sediment moving along the base of the breakwater. Komar's interpretation was:

> "…that the constructed breakwater in effect behaves as a headland, an extension of Bluff Hill, accounting for the advance of the shore at the time of construction, but now the beach gravel and coarse sand arriving from the south is consumed by abrasion, as found in the experiments of Marshall (1927), converting it to the fine sand and silt component of the greywacke, which only then is able to move offshore and around the breakwater's arm" (Komar, 2010).

64 Erosion along the southern portion of Westshore Beach has resulted in a number of mitigation measures undertaken since as early as 1909, when protection works were undertaken to protect the seaward face of the reclamation on which Whakarire Avenue is located. The protection work was maintained up until the 1931 earthquake. Consent was granted in 2016 to construct new shore protection along the Whakarire Avenue foreshore, including a rock revetment, a wave spending beach and modification to the existing seawall within the Coastal Marine Area (HBRC Consent No. CL130257C).

65 Erosion further north along Westshore Beach in the late 1970s and early to mid-1980s resulted in a program of beach renourishment being undertaken. Since 1995, an annual average of approximately 10,000 to 12,000 m^3 of fine gravel has been placed along the Westshore foreshore to nourish the beach and maintain the artificial gravel beach ridge. In addition, the Port has also placed dredge spoil, from the maintenance dredging of the navigation channel, in shallow water off Westshore since at least 2012. The work by Advisian shows that of this material, a small percentage of the total placed contributes to beach replenishment. This is because the sediment is generally smaller in size than is effective for beach nourishment. Only the coarser sand fractions are transported onshore and the residence time on the beach is limited due to ongoing northward net beach sediment transport. Finer sediments in the dredge spoil are transported offshore and to the east and southeast, and can eventually contribute to infilling of the harbour channels (Ahuriri and the port) with fine sediment. Maintenance dredging records show infilling of the western edge of the port navigation channel, resulting in an

asymmetrical dredge demand between the western and eastern sides of the channel.

Recent capital and maintenance dredging history

66 In November 1998 the Port was granted consent to deposit up to 350,000 m^3 of dredge spoil over any 12 month period at locations for disposal shown on Figure 2.16 of my report. Area "R ext". allowed for deposition that may provide sand nourishment to Westshore, and as per condition 6 of the consent, can only receive material dredged from the fairway.

67 Since 1999, only sediment from the fairway has been placed in area "R ext.", where the coarser fractions of sand sized particles (medium and coarse sand) would be available and suitable to move onshore. The finer fractions of this material are unlikely to nourish the beach due to the transport properties of the fine sediments. Recent studies have shown that the fine material moves to the east and south, potentially relocating to the harbour and navigation channel.

68 Since 1998 (under consent CL970159D) nearly 400,000 m^3 has been placed at the inshore site ("R ext."), averaging about 22,600 m^3 per year. Based on the sediment characteristics of the fairway surface sediments, between 5% and 10% of the dredged material from the channel is sand greater than 300 mµ diameter (medium to coarse sand) that has potential to move inshore to nourish the beaches of Westshore. This equates to potentially between 1,100 and 5,600 m^3 per year of placed dredge spoil that may temporarily nourish the beach.

CHANGES TO THE PROCESS ENVIRONMENT AS A RESULT OF THE PROJECT

Modelling

69 A series of numerical models were used to simulate the coastal process systems around Napier. Wave, current and sediment transport processes were modelled using the Delft3D suite of models. Sediment transport in the littoral zone (near to shore and under breaking waves) was simulated using Unibest. Wave refraction and shoaling were modelled using MIKE21BW. These models are appropriate for the nearshore and offshore coastal process environment in the area.

70 Numerical models for sediment transport on mixed sand and gravel beaches are not quantitatively precise due to the complex mix of the sediment sizes. Therefore numerical models of littoral and beach transport were used to determine relative changes in the process energy from the existing channel situation to the conditions at completion of the proposed work, and the potential to change the coastal environment, rather than to determine quantitative changes to shore geometry and sediment transport.

71 The models were calibrated against field data collected from long-term deployments and for this project. The calibrated 3d flow model was verified against Acoustic Doppler Current Profiler (ADCP) data. Wave heights and periods of the model were also calibrated to measured data,

and verified against storm events. The model performed at 'excellent' level in reproducing wave heights, periods and direction.

72 Data-driven and model-driven approaches were used to assess sediment transport processes around the port and the disposal areas. This resulted in the identification of sediment transport potential, transport pathways. With reference to the sediment sizes present on the wider seabed and within the proposed dredge area, the relative transport of different sediment size fractions could be determined.

73 Overall, the model results allowed for good calibration, with consistent findings between models, field measurements and observations. This meant that the models provided a dependable platform for assessing changes to the wave environment and assessing sediment transport (suspended-sediment plume, bedload, and resuspension of placed sediment at disposal sites).

74 The findings of the model studies, combined with field observations were used to assess options for design of the channel configuration and options for the location of dredged sediment disposal.

Waves

75 Analysis of the wave climate was carried out for the existing or 'baseline' situation and for the dredged channel bathymetry. The difference between the baseline and dredged channel results gives the change to wave height and direction.

Effects of the deeper channel on the wave climate

76 Seven different alternative dredge footprints were assessed before settling on a final design. Figure 3.1 of my report shows the energy-weighted mean wave height and direction for the baseline condition and for the fully dredged channel (-14.5 m CD). The general finding is that there is very little change in the vectors of wave height and wave approach to the shore. Changes in mean wave height are small, with a decrease in mean wave height of about 5 cm at Port Beach, an increase of about 6 cm at East Pier, a decrease of less than 2 cm along Westshore, and an increase of about 2 cm at The Gap.

77 The deeper channel causes the wave approach to be less refracted as it passes the channel, and so there is slightly more angle to the wave approach to the shore. The influence of the channel dredging decreases to the west and north along Westshore.

Effects on surfability of waves

78 The New Zealand Coastal Policy Statement (NZCPS), Policy 16 recognises the need to protect surf breaks of national importance. The local breaks are not nationally significant (as per Schedule 1 of the NZCPS). They are important to local surfers, and are identified and rated on the web site Surf Seeker NZ, advertised as the comprehensive New Zealand surf guide.

79 Model simulations to assess the surf breaks considered wave refraction, diffraction, non-linear wave interaction, wave asymmetry and skewness, and depth induced wave breaking. The models showed negligible effects at The Gap and Westshore. The closer breaks at City Reef and Hardinge Road were examined in more detail. Results showed that during an easterly storm occurring at low water, there is a small increase in the significant wave height along Hardinge Road, and a small increase in wave height at the City Reef break. There are also increases of about up to 0.4 m to the maximum wave height.

80 For the model storm conditions, the wave crests are predicted to remain broadly unchanged by the deeper channel. However the increase in wave height suggests that wave scattering from the swing basin will enhance the potential for a long ride along Hardinge Road. Chris Adamantidis discusses these findings in more detail.

Effects of disposal mound on the wave climate

81 Placement of approximately 3.2M m^3 of dredge spoil at the proposed disposal ground will result in a modest increase in the elevation of the seabed. The Port estimates the increase over the disposal area will be in the order of about 1 m. The effective shallower depth can result in changes to wave propagation and refraction over the area, the amount of energy that reaches the beach and the angle of wave breaking at the shore.

82 Simulated wave refraction was carried out across the existing bathymetry and the modified bathymetry of the disposal area east of the port.

83 The effect of the spoil placement on wave refraction is limited to changes in wave energy in the area immediately west of the disposal ground. Wave height is modified due to wave refraction across the disposal ground, but it is limited to a maximum change in energy-weighted wave height of ±4 cm at the shore. There is no change to the energy-weighted wave direction at the shoreline.

84 These small changes in predicted wave energy will not result in measureable changes to the geomorphological work the waves will do at the shore.

Sedimentation

85 It is expected that the proposed dredging programme will result in changes to patterns and processes of sedimentation in the immediate vicinity of the port and the proposed disposal area(s). Changes will result from:

(a) Addition of fine sediment into the water column and environment during the dredging activity (excavation in the channel and swing basin, and deposition at the disposal ground);

(b) Changes to the margins of the dredged area as the sides of the channel and margin of the swing basin “relax” into an equilibrium condition; and

(c) The addition of the dredged sediment onto the offshore seabed.

86 During the disposal operation, when the dredge hopper is emptied at the proposed disposal ground, the following processes would occur:

(a) A major portion of the released sediment load descends rapidly en masse to the seabed and deposits itself there;

(b) A minor portion of the sediment load goes directly into suspension (especially finer size fractions), increasing the concentration of suspended material in the water column and drifts off with the current, dispersing and gradually settling with time;

(c) Finer material (e.g., silts) within the mass that falls directly to the seabed will spread out radially along the seabed away from the impact zone;

(d) Deposited material can be subsequently re-suspended when wave conditions are sufficiently strong to mobilise the seabed surface sediments and transported by currents before settling again when conditions allow.

Plume concentrations and spatial extent

87 The modelling results show concentrations of suspended sediment in mg/L (equivalent to parts per million, ppm) above background levels. There is little quantitative data on background suspended sediment concentrations, for the coastal area off Napier. However work by Worley Parsons Ltd in 2005 shows suspended sediment concentrations induced by wave and current re-suspension near the seabed of between 2 to 3.1 mg/L. Cawthron Ltd also note that there are high concentrations of background turbidity at Pania Reef as a result of large river flows, and fine material resulting from abrasion of sediment on the beach. Only the silt and finer fractions of sediment are represented in the sediment concentration as sand fractions quickly settle out of the water column and onto the seabed in the immediate vicinity of the area of disturbance (dredging and disposal).

88 The results from the modelling allow general observations to be made:

(a) The plume generated at the proposed disposal ground was more extensive than that generated at the dredge site, for all scenarios tested;

(b) Sediment concentrations are spread relatively evenly over the water column;

(c) There is no potential for sedimentation to occur at Pania Reef due to re-suspension of sediments by wave-induced stirring, the distance of the ground from the reef, and the prevailing current directions;

(d) There is no potential for Pania Reef to be affected by suspended sediments >10 mg/L above background, with 98%ile Silt/clay fraction concentrations (exceeded for less than 1 day per month during the dredging campaigns) less than 10 mg/L above background levels over the reef area;

(e) The sand fraction of the discharge settles quickly and does not travel long distances from the source location;

(f) The highest suspended sediment concentrations above background levels are in the inner port area and at the spoil ground;

(g) The highest concentrations occur at the beginning of the campaigns due to TSHD dredging dominating, lower concentrations result from backhoe dredging; and

(h) Suspended sediment concentrations at the reef are negligible, being at their 'highest' during times when the currents at the spoil ground are directed toward the northwest but are still well below 10 mg/L above background and would not be visible to a casual observer.

89 These results are consistent with the current modelling findings of fine sediment movement on the seabed in the general area from north of Westshore to Marine Parade. The prevailing currents are generally directed toward the east, and result in sediment plume movements from the proposed disposal site to offshore and away from Pania Reef.

90 Based on the model findings, Advisian concluded that there is no potential for dredging to result in near-surface suspended sediment concentrations adversely affecting Pania Reef, as concentrations greater than 10 mg/L above background levels will be exceeded for less than 2% of the time during the dredging campaigns. I agree with their conclusion.

91 Deposition of fine silt fractions on Pania Reef is also not predicted to occur due to the distance from the dredging operations, and limitations to settling at Pania Reef because of natural wave action.

Long term sediment transport from the disposal ground

Sediment mobility and potential deflation of the disposal mound

92 Based on currents measured at the proposed disposal site, for a depth of 20 m, the percentage of time each year that sediments of different sizes could be moved as bedload and / or re-suspended was calculated. Due to the depth, potential for re-suspension of sediment is low (much less than 1%).

93 With regard for potential mobility of the sediments placed at the proposed disposal ground, the modelling assessment suggests that the potential for sediment movement from the proposed disposal ground is considerably less for all silt and fine sand sediment size fractions than for the disposal sites west of the port in depths of 10 m (near the channel approaches) and 6 m (inshore near the Beacons and Westshore).

Direction of sand movement

94 From data measured and analysed to the time of lodgement of the consent, currents at the proposed disposal site are almost exclusively to the south.

95 In comparison to the sites west of the port, the following observations are made:

(a) The potential magnitude of transport at the proposed disposal site is about a third of that estimated for the shallower sites. The model results show that measureable sand transport from the proposed disposal site occurs only during strong NW winds and is directed to the south.

(b) Although current speeds are generally higher at the proposed disposal site, the greater water depth reduces the ability for waves to initiate or re-suspend sediment for transport by ambient currents.

(c) For the current data available to date, sediment will be transported away from Pania Reef over 90% of the time.

Potential for turbidity plume generation

96 Stiff, silty sandy clay deposits dredged from the navigation channel will be deposited rapidly to the seabed and may become a source of turbidity during storm events as the material is slowly eroded. Investigations were carried out to assess the potential for erosion and transport of medium and coarse silt during storm events from the six main wind directions using the 3D hydrodynamic and sediment transport model.

97 The results show:

(a) Only wind from the west produced turbidity plumes that extend over Pania Reef.

(b) Using conservative assumptions about storm intensity and duration for wind events, the maximum suspended sediment concentration expected over parts of Pania Reef are 2 mg/L above ambient in the surface of the water column, and 4 – 6 mg/L above ambient levels at the bottom of the water column.

(c) Although fine sediments may be suspended and transported over the reef, permanent deposition will not occur due to wave action and turbulent currents at the reef inhibiting deposition.

THE DIRECT AND INDIRECT EFFECTS OF THE PROPOSED WORKS

98 The potential effects on the physical coastal environment due to the proposed dredging activity and deeper shipping channel include:

(a) Potential changes to the wave environment as a result of deepening the entrance channel and disposal of sediment.

(b) Changes to patterns of sedimentation in the wider coastal area.

(c) The dispersal of fine sediments due to the dredging and disposal operation.

Effects of changes to the wave environment

99 Changes to the wave environment as a result of refraction across the deeper channel and over the disposal ground mound will be small in magnitude and are unlikely to have a persistent geomorphological effect at the shoreline except in the immediate lee of the channel and swing basin in the vicinity of Port Beach. There will be no noticeable effect on surfing conditions and there will be no changes to existing patterns and variability

of beach response to changes in the wave environment. In particular, there will be no increase in erosion or inundation hazards at the shore.

Wave environment inshore of the deepened channel

100 Changes in mean wave height are small, with a decrease in mean wave height of about 5 cm at Port Beach, an increase of about 6 cm at East Pier, a decrease of less than 2 cm along Westshore, and an increase of about 2 cm at The Gap.

101 The deeper channel causes the wave approach to be less refracted as it passes the channel. The resulting change is by about 4 degrees, near to the port, to less than 1 degree at Westshore, and no change to the angle of wave approach to the shore north of The Esplanade.

102 At Port Beach, there is potential for smaller waves (and less energy) to result in the beach being slightly more accretional than at present. There may be a small increase in sediment transport along the beach and nearshore at East Pier (Perfume Point reserve) towards the Ahuriri inlet channel. However, adjustment of the beach shape in plan is likely to be minor.

103 The slight decrease in wave energy in the southern section of Westshore and the slight rotation of the breaking wave angle to the north along the beach may result in sediment moving north on the beach face, but to the south in the littoral zone and the nearshore. However the magnitude of projected changes are small in comparison to the natural variability of conditions, and there is unlikely to be any measureable long-term adverse or beneficial change to the long-term geomorphological beach response to the wave environment.

Effects on surfability of waves

104 Wave modelling of the change to the wave corridor with regard to the surf breaks west and north of the port showed negligible effects at The Gap and Westshore.

105 Although there is a decrease in significant wave height at Port Beach, there is a small increase in the significant wave height along Hardinge Road, and an increase of up to about 0.4 m in maximum wave height. The increase in wave height suggests that wave scattering from the swing basin will enhance the potential for a long ride along Hardinge Road. The peel angle increases slightly following dredging and there is slight improvement to the surfing amenity classification, with a greater proportion of waves at the break more suitable for surfing.

106 There is also a small increase in wave height at the City Reef break (Whakarire Avenue) and an increase of about 0.4 m to the maximum wave height. For both the right and left hand breaks at City Reef, the peel angle and surfing amenity classification will not change significantly as a result of the dredging.

Wave environment inshore of proposed sediment disposal ground

107 The effect of the raised seabed on wave refraction at the proposed disposal ground east of the port is limited to changes in wave energy in the area immediately west of the disposal ground. Small changes in predicted wave energy are limited to the area immediately onshore of the disposal ground, extending to less than 1 km south of the Town Reef. The changes will not result in measureable changes to the geomorphological work the waves will do at the shore.

Effects of changes to sedimentation processes

108 It is expected that the proposed dredging programme will result in changes to patterns and processes of sedimentation in the immediate vicinity of the port and the proposed disposal area. Changes will result from:

(a) Addition of fine sediment into the water column and environment during the dredging activity (excavation in the channel and swing basin, and deposition at the disposal ground);

(b) Changes to the margins of the dredged area as the sides of the channel and margin of the swing basin “relax” into an equilibrium condition; and

(c) The addition of the dredged sediment onto the offshore seabed.

109 Sedimentation process effects include turbidity in the harbour, at the dredged sediment placement site and areas in-between, changes to wave refraction and sediment movement on the seabed as a result of placement of dredged sediment, and possible changes to maintenance dredging operations as a result of the deeper channel.

Turbidity and spatial extent of plumes

110 The dredging activity will result in suspended sediments being added to the water column resulting in turbidity. Sand particles will rapidly drop to the seabed, while silt and finer sediment concentrations will be relatively evenly spread through the water column.

111 During dredging, the plume generated will be very localised to the area worked. Sand overfill (spilling from the dredge hopper) will settle quickly. The highest concentrations occur at the beginning of the dredging campaigns due to trailer suction hopper dredge dominating. Lower suspended sediment concentrations result from backhoe dredging.

112 Deposition at the disposal ground will generate a more extensive plume than the dredging. As with overfill, settling of the sand fraction will occur rapidly and will not travel far from the discharge site. Modelling for a large range of wave and wind and resulting current scenarios showed that there is no potential for Pania Reef to be affected by suspended sediments >10 mg/L above background.

Deposition of sediments and turbidity plume generation from the disposal ground

113 The proposed offshore disposal ground east of the port has similar in situ sediment characteristics to the material to be dredged. The deposited sediment will result in a mound being built on the seabed, and this mound will intercept and transfer fine sediments moving on the seabed. The wave and current energy at the disposal area is not sufficient to cause mass movement of the deposited sediment away from the site, but the small volume of medium sand fraction may be winnowed from the site and move onshore.

114 Although fine sediments may be suspended and transported over Pania Reef, deposition of re-suspended fine silt fractions from the proposed disposal ground is not predicted to occur due to the distance from the disposal ground, and limitations to settling at Pania Reef because of natural wave action.

115 Modelling results show that only wind from the west produced turbidity plumes that extend over Pania Reef. The models also showed that the maximum suspended sediment concentration expected over parts of Pania Reef are 2 mg/L above ambient in the surface of the water column, and 4 – 6 mg/L above ambient levels at the bottom of the water column.

116 The Cawthron report also notes that turbidity and sediment deposition and re-suspension on Pania reef due to the dredging programme will be of a similar order of magnitude to ambient conditions, and will not lead to adverse ecological effects at the reef.

Sand transport patterns from the proposed disposal ground

117 The proposed disposal ground does not result in sediment transport back into the dredged channel. This is an important consideration in determining the ideal disposal site. Sites west of the port and inshore towards Westshore will act as source areas for fine sand and silt to move to the southeast and back to the navigation channel.

Effects on the present pattern of maintenance dredging

118 Although sediment will not move from the proposed disposal ground east of the port back towards the navigation channel, the deeper and longer channel across the seabed is likely to result in additional capture of sediment moving naturally within the area. Although the quantity of this increase is unknown, it is likely that the interception rate and required maintenance dredging will be at least of the same order of magnitude as at present.

RESPONSE TO MATTERS RAISED IN SECTION 42A REPORT

119 I have read the Section 42A report and the attachments, and note the inclusion of proposed conditions under the heading “Disposal of Suitable Material for Beach Nourishment”, to “dispose of all suitable material within Area “R” Ext as authorised by CL970159D (or any subsequent consent)” (Condition 18 of CL180009E and Condition 17 of CL180010E

and CL180011E), based on the points made in paragraphs 89 to 93 of the Section 42A report.

120 I do not agree that the inclusion of these conditions mitigate an effect relating to the proposed activities. The effects of the proposed dredging and deeper channel have been shown to be very small with regard to the physical coastal processes at Westshore. Small changes to the angle of wave approach are within the natural variability of the wave environment.

121 Although the potential increase in the trapping efficiency of the deeper, longer channel has potential to result in an increase in the maintenance dredging demand, sediment accumulates in the channel from sources to the east and west. This sediment generally comprises silty, fine to medium sand and is not material that would naturally nourish Westshore Beach.

122 Ben Williams presents his assessment of the suitability of the dredged sediment as beach nourishment. He found that the material present in the channel bed is not suitable for such a purpose. I agree with his findings. The very small proportion of medium to coarse sand present in the dredged sediment will winnow slowly from a nearshore placement such as at the inner parts of Area “R ext.”, but would not be an effective mitigation of the erosion of the beach.

RESPONSE TO MATTERS RAISED IN SUBMISSIONS

123 I have considered the submissions that have raised issues relating to the scope of my role in the Project, in particular relating to the coastal geomorphology and sediment transport processes. The main themes from those submissions are as follows:

(a) Use of the dredged material as a resource for beach nourishment.

(b) Deposition site too close to the shore and Pania Reef.

(c) Erosion of Westshore Beach as a result of the Port of Napier blocking sediment transport from the south.

(d) Effects on surfing breaks.

(e) Effects to the shore north of the Esk River mouth.

Use of material for beach nourishment

124 The following submissions sought that dredged sand should be deposited close to Westshore Beach in order to provide nourishment to the shore or to increase the nearshore seabed sediment volume:

Chris Hart

Jeremy Dunningham

David Ship

Denis and Diane Cadwallader

Denis Pilkington

Stephen Laughlin

Dorothy Pilkington

Westshore Residents and Development Association Inc.

Lauren Hart

Napier City Council

Richard Karn

Larry Dallimore.

125 A number of these submitters support the application with a condition that sand is deposited off Westshore Beach. As noted in the technical reports accompanying the application, Port of Napier has deposited dredged sediment close to Westshore Beach in the past. I am also sympathetic to the use of dredged sand as a resource for beach renourishment where appropriate, and have recommended this action in suitable circumstances, such as at Shelly Beach at the head of Otago Harbour.

126 Ms Allan addresses this issue with regard to the scope of the application and consents, while Mr de Vos presents the Port position on inshore dredge deposition. I do not discuss the merits or not of beach nourishment at Westshore, as that is not an aspect of the Port application. I am familiar with the issue, having grown up in Napier, with Westshore Beach part of my childhood in the 1960s and 70s. I wrote my Masters thesis on the effects and subsequent geomorphological adjustment of the 1931 earthquake uplift on the beaches and nearshore of Napier, and with Professor Bob Kirk, investigated the range of causative factors of coastal change at Napier. I have also kept up with the debate from media reports and the views of coastal scientists, such as Dr Jeremy Gibb, Dr Shaw Mead, Professor Paul Komar, Richard Reinen-Hamill and Associate Professor Peter Cowell.

127 Advisian modelling shows that sediment dispersion from the inshore site off Westshore depends on the sediment particle size, with coarser particles moving onshore and along the beach, and finer particles being suspended and moving offshore and to the south towards the shipping channel. I agree with those findings.

128 In my opinion, most submitters consider all material described as "sand" to be homogenous. However this is far from the case for the Napier seabed sediments. In particular, there are differences between the sand that is competent as "beach" sediment, and that found in the nearshore and the shipping channel. Mr Karn presents a graph of a sediment sample from about 1 m water depth offshore of Westshore surf life-saving club. This is consistent with that shown in Figure 2.11 of my report.

129 Sand ranges in particle size from 0.0625 mm up to 2.0 mm in diameter. As can be seen from the sediment distribution map, most of the sand on the seabed off Napier is very fine sand, with particles less than 0.125 mm in diameter. Sand particle sizes on Westshore beach are generally medium to coarse, with fine sand size particles (about 0.17 to 0.25 mm in diameter) mantling the beach exposed at low tide. Finer particles pass through the beach system, but are too small to remain on the beach and tend to be transported offshore.

130 The geotechnical studies of the sediment character of the proposed dredging area show the sediments to be composed of:

(a) Approximately 20% of sediments are finer than 0.1 mm;

(b) Approximately 70% of sediments are sized between 0.1 mm and 0.2 mm;

(c) Approximately 10% of sediments are coarser 0.2 mm, 5% coarser than 0.3 mm than 0.1 mm and 1% coarser than 0.5 mm;

(d) The median (d50) particle diameter is approximately 0.125 mm.

131 Advisian sediment transport modelling found that medium and coarse sand is removed from the shore during storms but can be moved onshore in calmer conditions and dispersed along the shore by wave run-up and littoral currents in the surf zone. Finer fractions (less than 0.125 mm) are transported offshore and to the south. These patterns of transport are consistent with the spatial distribution shown from the seabed samples.

132 With regard to the Port activities, placement of dredged sediment inshore (in the nearshore) at Westshore has potential to create a new source of sediment that will be transported back to the shipping channel. There are other potential effects in that fine silts and muds that may be present in the dredged sediment may be put into suspension and result in adverse effects to the beach and Rangitira (or City) Reef and as far as Pania Reef. Sediment moving to the south from the Westshore inshore disposal may also result in unwanted sedimentation at Ahuriri, in the inlet and possibly in the harbour.

133 In my opinion, the potential adverse effects at Westshore counter the potential and/or perceived beneficial effects of disposal of the dredged sediment inshore. If Napier City Council (for example) were to pursue the use of the dredged sediment as a resource for nourishment of Westshore Beach, they will need to assess the effects of that activity in full.

Deposition site too close to the shore

134 The following submissions expressed concern that the proposed deposition site was too close to the shore (off Marine Parade) and would have a detrimental effect on Pania Reef:

Chris Morris

Alex Jones

Aaron Duncan

Jamie Hunt

Daniel Somerville

Karl Warr

Napier Fisherman’s Association

Legasea Hawke’s Bay

Conor Paul

Ngaio Tiuka

Trevor Moeke

NZ Angling and Casting Association

Fisheries Inshore NZ

Maungaharuru Tangitu Trust

Freedom Divers (Spearfishing) HB

135 The concerns related mainly to a perceived increase in fine sediment covering shellfish beds and adversely affecting Pania Reef. These concerns were an explicit consideration in siting the proposed disposal site. Data collection of currents and modelling of sediment dispersal from proposed disposal sites was carried out to identify potential adverse effects of sediment deposition and movement of fine sediment from the site. The Advisian technical reports present the findings of this work in detail, and the Cawthron report presents the findings of research on Pania Reef and the benthic ecology. I consider that the modelling by Advisian is appropriate, and the findings have been used to provide a suitable location for the disposal of the dredged sediment. The identification of the background turbidity and potential effects of fine sediment settling on Pania Reef by Cawthron is consistent with the results from the models.

Erosion of Westshore Beach as a result of the Port of Napier blocking sediment transport from the south

136 Denis Pilkington, Kelly Richards and Glenn Abel consider that the Port has had an historical effect with dredging of the shipping channel resulting in erosion of Westshore Beach. In particular Denis Pilkington notes that "There is evidence to suggest that the erosion of the beach over the last 30-40 years resulted from the blocking of the natural supply of replenishing sand that drifted north around the end of Bluff Hill by deeper dredging of the shipping channel at the port."

137 Historical effects of the port have been examined by a number of researchers, including myself, over the years. I have presented a synthesis of the findings of that research. I am aware that different coastal specialists have presented differing views as to the effects of the shipping channel on sediment transport. For example Professor Paul Komar does not consider that the channel has intercepted a volume of beach sands and gravels that would account for erosion at Westshore Beach, in contrast to earlier statements by Dr Jeremy Gibb that the breakwater is likely to have intercepted large volumes of beach sediment.

138 There are many agents of change to the coastal geomorphological processes in the Napier and Westshore area. The effects of the proposed channel deepening have been assessed in relation to the existing environment, although with consideration of cumulative effects. The findings of Advisian through modelling and from their and my assessment of the geotechnical information of the seabed in the vicinity of the channel show that there is no adverse effect of the channel deepening on Westshore Beach, or the shore to the north of the port. I have addressed earlier other aspects of this concern with regard to the placement of sand near to Westshore Beach.

Surf breaks

139 Glenn Abel opposes the application on the basis of an effect on erosion at Westshore and on the surfable waves for Hardinge Road and the City Reef. The Surfbreak Protection Society supports the application, and state that "baseline data provided to our own peer reviewers that adverse effects on the four listed surf breaks are unlikely."

140 As noted, the local surf breaks are not listed as Nationally Significant under the NZCPS (Policy 16 and Schedule 1). The agreement of the findings of Advisian and my own assessment of their results, and the peer reviewers from the Surfbreak Protection Society of no adverse effect does not require additional monitoring nor adaptive management with regard to the Napier surf breaks as proposed by the Surfbreak Protection Society.

141 I was part of the scientific team advising Port Otago on coastal processes related to their application for channel deepening, and worked with them from 2007 through the successful application process and continue to advise in the adaptive management process during the project. The Surfbreak Protection Society engagement with Port Otago has been and continues to be very positive, especially with regard to the Nationally Significant surf breaks at Aramoana and Whareakeake. However I do not consider that the same degree of engagement is necessary for Port of Napier.

Effects to the shore north of the Esk River mouth

142 Maungaharuru Tangitu Trust request that the "effects of the port operations and the related dredging on Tangoio Beach be included in the MCHP". The results of modelling of the effects on the wave environment and sediment transport during dredging and as a result of deposition of dredged sediment at the proposed disposal site do not indicate effects to the north of Esk River or on Tangoio Beach. Detailed analysis and identification of adverse effects were not carried out for areas outside the area of effects, resulting in Tangoio Beach not being included in the effects assessment of the application.

CONCLUSIONS AND RECOMENDATIONS

143 The coastal area around Napier is characterised by the mixed sediments of the beaches and the fine sediments on the seabed. The wave environment is dominated by long-period swell from the east with other waves of moderate energy coming from the northeast.

144 The 1931 earthquake caused the coast and nearshore seabed to rise, and the coast has continued to adjust to that change. The construction of the port breakwater, and dredging of channels have also resulted in change to the coast, mainly in providing a sheltering effect to the shoreline to the west of the port.

145 Studies were carried out to identify the effects of deepening the channel on the wave environment and sediment transport in the nearshore. Studies were also carried out on assessing the most suitable sediment disposal site with the least adverse effect.

146 The main considerations for the effects on the physical coastal processes in relation to the dredged channel and disposal at the selected site relate to the potential changes in the wave environment, changes to the sedimentation patterns in the wider coastal area and dispersal of fine sediments due to the dredging and disposal operation.

147 Studies carried out to investigate the effects have shown that they are mostly negligible, and of magnitudes within the variability of the natural environment.

148 Apart from the raising of the seabed topography of the channel and at the disposal site, I consider that the effects of the dredging and disposal operation on the physical coastal environment will be negligible.

149 In my opinion the conditions proposed by the Port with regard to monitoring and reporting are appropriate for the activity. Bathymetric surveys and beach surveys will provide adequate data to assess the ongoing effects on the physical coastal processes.

150 It is also my opinion that the conditions proposed in the Section 42A report under the heading "Disposal of Suitable Material for Beach Nourishment" (Conditions 18-20 of CL180009E and Conditions 17-19 of CL180010E and CL180011E) are not an appropriate response to the likely effects of the dredging and disposal activity, and would not result in effective nourishment of Westshore Beach due to the composition of the dredged sediments.

Martin Bernard Single

3 August 2018