BEFORE THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER OF	the Resource Management Act
AND	
IN THE MATTER OF	Four Resource Consent Applications by Lyttelton Port Company Limited to undertake various activities within Lyttelton Harbour and offshore surrounds associated with the Channel Deepening project:
	CRC172455 – a coastal permit to disturb and deposit seabed material for the purposes of deepening, extending and widening a navigation channel; and construction of a reclamation
	CRC172522 – a discharge permit to discharge contaminants (seabed material and water) into water associated with channel deepening dredging
	CRC172456 – a coastal permit to disturb and deposit seabed material for the purposes of maintaining the depth of a navigation channel
	CRC172523 – a discharge permit to discharge contaminants (seabed material and water) into water associated with maintenance dredging

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DECISION OF HEARING COMMISSIONERS

SIR GRAHAM PANCKHURST (Chair), PETER ATKINSON AND RAEWYN SOLOMON

Contents

Abbreviations/Acronyms

ADP	Accidental Discovery Protocol
ADCP	Acoustic Doppler Current Profiler
AEE	Assessment of Environmental Effects
ALG	Aquaculture Liaison Group
BPAR	Benthic Photosynthetically Active Radiation
BSL	Benthic Self-Logger
BMP	Biosecurity Management Plan
CDP	Channel Deepening Project
CHPT	Consent Holder Project Team
CIA	Cultural Impact Assessment
CRC	Canterbury Regional Council
CRMS	Craft Risk Management Plan
DMP	Dredge Management Plan
EMMP	Environmental Monitoring and Management Plan
HIS	Import Health Standard
LPC	Lyttelton Port Company
MAG	Manawhenua Advisory Group
MMMP	Marine Mammal Management Plan
m-IDF	modified – Intensity Frequency Duration
NTU	Nephelometric Turbidity Unit
PRG	Peer Review Group
SL	Self Logger
ST	Subsurface Telemetry
TAG	Technical Advisory Group
TSHD	Trawler Suction Hopper Dredge
TSS	Total Suspended Solids
TV	Trigger Value
WK	Watchkeeper Telemetred Weather Station

Maori Definitions

Ariki	paramount chief
Atua	god, diety
Hapū	collective of extended whanau related by whakapapa - sub tribe
Harakeke	flax
Kaimoana	sea food
Kaitiaki	iwi, hapū or whānau group with the responsibility of Kaitiakitanga
Kaitiakitanga	guardianship of the natural environment
Karakia	prayer, incantation, ceremony
Kaumātua	elder
Kaupapa	theme, policy
Kawa	rules, protocols or procedures
Ki Te Ara Whānui a Makawhuia	Koukourārata Harbour
Ki uta ki tai	reflects the holistic nature of traditional resource management , particularly the interdependant nature and function of the various elements of the environment within the catchment, loosely referred to as - "from the mountains to the sea" (includes the coastal marine area)
Kohanga	nursery, spawning ground
Kōiwi tangata	human bones
Kōrero pūrākau	oral traditions
Kōura	crayfish
Kūtai	mussel
Mahinga Kai	Iwi/hapu interests in food and other natural resources and the sites, habitats and practises associated with those resources including marine farms. 'Kai' means food, 'mahi' means work, and 'nga' denotes that it's plural
Mana	respect, dignity, influence
Manaakitanga	hospitality, kindness
Manawhenua	hapū who hold manawhenua and manamoana (customary authority) to their traditional takiwa, and the power associated with the possession of lands - manamoana is specific to the coastal marine area
Manuhiri	visitors
Mātauranga	knowledge

Mauri	the essential life force of all things, spiritual essence
Mokopuna	grandchildren
Ngāi Tahu Iwi	are Māori specific to much of the South Island and is made up of a collective of hapū related by whakapapa
Ngāi Tahu Whānui	the wider tribal membership
Pā	fortified settlements
Pāpaka	crab
Papatipu Rūnanga	Marae based councils, administering the affairs of the hapū
Papatūānuku	Mother Earth
Pātiki	flounder
Pātiki rori	sole
Pioke	rig
Pipi	cockle
Rāhui	restriction or control on an area
Rangatira	chief, leader
Rangatiratanga	chieftanship, self determination
Ranginui	Sky Father
Rimurapa	bull kelp
Taiki	coastal storage pits
Takiwā/Rohe	region, tribal or hapū traditional territory
Tangaroa	God of the sea
Tangata Tiaki	individuals who can authorise customary fishing
Tangata Whenua	people of the land, in this context it means Te Hapū o Ngāti Wheke for Lyttelton Harbour area, and for Te Rūnanga o Koukourārata it refers to the harbour of Koukourārata
Taonga	treasures
Tauranga Ika	fishing grounds
Tauranga waka	canoe landing site
Te Pātaka o Rakaihautu	Banks Peninsula
Te Tai o Mahaanui Statutory Acknowledgement Area	coastal marine area of Banks Peninsula and Selwyn between the Hurunui River and the Hakatere (Ashburton) River
Te Waipounamu	South Island
Tikanga	customary values and practices
Tipuna/Tupuna	ancestor

Tohunga	experts
Tuna	eel
Tio	oysters
Tūaki	cockle
Tuatua	shellfish
Urupā	burial site
Utu	balance, reciprocity
Wāhi taonga	places and things that are treasured and valued
Wāhi tapu	places and things that are sacred
Waiana kōiwi	underwater burial caves
Wainui	Goddess of the sea
Wairua	spirit
Waka	canoe
Whakapapa	geneology, cultural identity
Whakataukī	proverb
Whare tupuna	ancestral meeting house
Whanau	family
Whenua	land

1.0 Introduction

1.1 On 26 October 2016 the Lyttelton Port Company Limited (LPC) lodged a resource consent application with the Canterbury Regional Council, relating to its proposal to deepen, extend and widen the shipping channel that services Lyttelton Harbour/Te Whakaraupō. LPC requires a coastal permit to dredge seabed material and a discharge permit to discharge contaminants (seabed material and water) offshore in relation to the development project, and companion permits for ongoing maintenance dredging into the future.

1.2 Following public notification, 44 submitters responded to the application by 5 December 2016, the closing date for submissions. While a small number of submitters simply signified support for LPC's proposal, the large majority raised concerns relating to environmental issues but at the same time acknowledged the business and economic rationale that underpinned the application. A joint submission filed on behalf of Te Hapū o Ngāti Wheke; Te Rūnanga o Koukourārata, Ngāi Tahu Seafood and Te Rūnanga o Ngāi Tahu challenged certain technical aspects of LPC's proposal to adaptively manage its dredging and disposal activities, but also indicated that provided conditions were imposed that aligned with Ngāi Tahu's vision to :

> " a. protect, restore and enhance the mahinga kai values and water qualities of Whakaraupō (Lyttelton), Koukourārata (Port Levy) and the coastal waters; and
>
> b. to exercise kaitiakitanga and rangatiratanga",

consent could be granted.

1.3 A public hearing was conducted over several days between 2 and 12 May 2017, the Regional Council having delegated its decision-making function and powers to us, a panel of three Commissioners. Broadly speaking, the hearing comprised submissions from a modest number of individuals or organisations who raised concerns about potential adverse effects that needed to be avoided or mitigated, but otherwise was centred upon expert evidence adduced by LPC in support of the adaptive management regime it proposes to institute to safeguard the coastal environment; an evaluation of that evidence by experts on behalf of the Council; and both lay and expert evidence from Ngāi Tahu in relation to their concerns relating to the proposed management regime and their vision for Whakaraupō.

1.4 The complexities in relation to certain aspects of the adaptive management regime proved to be such that we did not close the hearing on 12 May. Draft conditions tabled on the last day included complex trigger mechanisms designed to manage and limit dredging and disposal activity if water monitoring indicated a defined level of environmental risk. We feared, rightly as it transpired, that this material might raise further questions to be put to and answered by LPC. The process of obtaining these answers has contributed to the delay in providing this decision.

2.0 LPC Dredging Application

2.1 LPC's planning for this project began in 2007. Consultation and assessment work went on through 2008 and 2009. An application was lodged with Environment Canterbury in December of that year. However the project was put on hold while the company focused on another project to reclaim land for the expansion of coal facilities. The application was left on hold and ultimately withdrawn after the major earthquakes of 2010 and 2011

2.2 These earthquakes resulted in severe damage to the Port of Lyttelton and it's then existing plan for growth was rendered irrelevant and inappropriate to the post-earthquake commercial and social environment. As a consequence, the Minister for Canterbury Earthquake Recovery directed Environment Canterbury to develop a Lyttelton Port Recovery Plan to enable the expeditious and efficient repair, rebuild and reconfiguration of the Port and its operations. This plan known as the Lyttelton Port Recovery Plan (LPRP) was gazetted in November 2015.

2.3 The LPRP was predicated on proposals, developed by LPC, that would enable the port to not only make good the damage caused by the earthquakes, but also efficiently provide for its reconfiguration to meet the demands of the emerging changes in international trade and shipping. Amongst these changes was the need to handle larger deep draught vessels being used for the container trade in particular. To do this, the dredging of the harbour entrance channel, turning basin and berth pockets is required. It is this activity, the dredging of the harbour that is the subject of this application.

2.4 The deepening of the shipping channel is to be known as the Channel Deepening Project (CDP). It consists of the following:

a) The deepening extension and widening of the existing shipping channel

b) The deepening and widening of the ship turning basin in the vicinity of the port

c) The deepening and enlargement of the existing berth pockets at Cashin quay

d) The creation of berth pockets to serve the future container facility at Te Awaparahi Bay

e) The on-going removal of sediment that accumulates in the channel over time

f) The removal of seabed material from within Te Awaparahi Bay to assist the construction of the reclamation.

2.5 The activities above require the following RMA consents:

Channel Deepening Dredging

CRC172455 – A Coastal Permit under section 12 of the Resource Management Act

i To dredge (disturb) seabed material for the purposes of deepening, extending and widening a shipping navigation channel that includes a ship turning basin and berth pockets; and

ii. To dredge seabed material in preparation for reclaiming land for a new container facility in Te Awaparahi Bay;

iii. To deposit seabed material on the seabed associated with (i) and (ii) above

CRC172522 – A Coastal Discharge Permit under sections 15, 15A and 15B of the Resource Management Act 1991:

iv. To discharge contaminants (seabed material and water) into water associated with channel deepening dredging as described in CRC172455; and

v. To discharge (dump) dredge material from a ship into water at the disposal ground as described in CRC172455; and

vi. To discharge contaminants (seabed material and water) from a ship into water associated with channel deepening dredging as described in CRC172455.

Maintenance Dredging

CRC172456 – A Coastal Permit under section 12 of the Resource Management Act 1991

i. To dredge (disturb) seabed material for the purpose of maintaining the depth of a shipping (navigation) channel that includes a ship turning basin and berth pockets to the extent authorised by CRC172455; and

ii. To deposit seabed material on the seabed associated with (i) above;

CRC172523 – A Coastal Discharge Permit under sections 15, 15A and 15B of the Resource Management Act 1991:

i. To discharge contaminants (seabed material and water) into water associated with maintenance dredging as described in CRC172456; and

ii. To discharge (dump) dredge material from a ship into water at the maintenance disposal grounds associated with maintenance dredging as described in CRC172456; and

iii. To discharge contaminants (seabed material and water) from a ship into water associated with maintenance dredging as described in CRC172456.

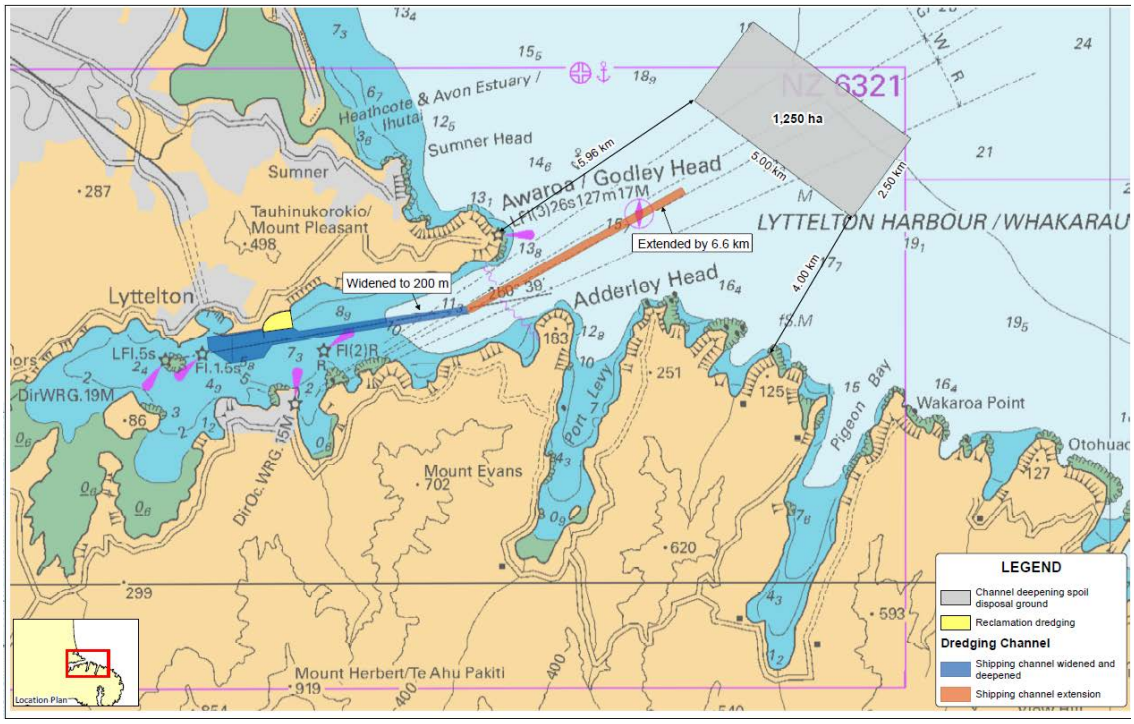


Figure 1: Diagram showing the proposed dredged channel and the offshore spoil disposal ground

2.6 The project will be carried out using a Trailer Suction Hopper Dredger (THSD) for the vast majority of the material. A Backhoe Dredger will be used in areas that are either inaccessible to the TSHD, or where the strength of the seabed material exceeds the ability of the TSHD to disturb it.

2.7 All capital dredging materials will be disposed of in a new 1250 hectare offshore disposal site. The maintenance dredging material is to be disposed of in a new 256 hectare maintenance disposal site east of Godley Head. However, the existing maintenance dredging ground that is licenced under consent CRC135318 is to be used for three purposes:

- As a backup ground for the smaller maintenance dredger when conditions would make the use of the outer maintenance ground unsafe.
- For the small volume of capital dredging that will need to be removed from areas close to the berths and transported by a towed barge.
- As a temporary ground in the event that adverse environmental effects from the use of the new offshore ground are detected

LPC have set a limit of 167,000 tonnes per year for this use.

2.8 The estimated volume to be removed in the CDP is 18 million cubic metres. The project is likely to be executed in at least two dredging campaigns. The duration of each campaign is expected to be about 9 months.

2.9 The new channel will be trapezoidal in shape, 200m wide at its base with side slopes of 1 vertical to 4 horizontal. Its depth will vary between 17.85m at the entrance, 17.25m at the transition zone (where a channel bend occurs approximately 6.6 km from the outer end of the extended channel) and 16.85 m from the transition zone to the turning basin. These figures are the depth below chart datum which is very close to Lowest Astronomical Tide.

2.10 The purpose of these dimensions is to allow all tide access (i.e.100% operability) to a container vessel carrying 8,000 to 10,000 TEU (twenty foot equivalent units. i.e. standard shipping container). Such vessels are typically 350 m overall length, 43 m beam and have a 14.5 m loaded draught.

2.11 Proposed channel dimensions have been determined using ship simulators to determine the width and space requirements and by using the 2014 edition of the PIANC guidelines to determine the depth requirements. It is noted that as the channel extends through the wave affected zones of the outer harbour and beyond, it needs to be deeper to allow for wave induced vertical movement of the vessel.

2.12 In response to a question from the panel, LPC advised that the channel dimensions are maximums and that optimisation is possible, particularly in the second stage when the critical entrance depths can be selected by taking into account the cost savings of a lessor depth, against the compromise of less than 100% operability.

2.13 The annual volume of maintenance dredging is not accurately quantified because the causal mechanisms are unclear. LPC have proffered a figure of 900,000 m^3/year, based on the experience from recent maintenance dredging.

2.14 The seabed sediments of Lyttelton/Whakaraupō are derived from the loess blown from the Canterbury plains during the period from 2.6 million to 11 thousand years ago. This loess forms a deep blanket approximately 47 m thick. The particle size distribution of this material is such that 82% has a median size (d_{50}) of less than 44 microns (m $x10^{-6}$). The remaining 18% has d_{50} values varying between 44 and118 microns. These sizes have very low settling velocities, which makes the loading process into the dredger hopper inefficient.

2.15 Dredging Methodology: LPC posits that Trailer Suction Hopper dredges are the type of dredger used world-wide for projects of this kind. They are capable of lifting large quantities of material in one load and moving it to the disposal ground efficiently.

2.16 LPC employed Mr Johan Pronk, a dredging consultant based in Australia, to advise on the type of dredger to be employed; and estimate the production capacity and likely duration of the stages of the project. He listed a variety of dredger sizes in the market with hopper capacities of 10,000 m3 to 19,000 m^3. In constructing his advice on production Mr Pronk assumed that a vessel with a hopper capacity of 17,000 m^3 and two drag arms (one each side of the vessel) will be used.

Figure 2: showing a trailer suction hopper dredger typical of that to be employed for the CDP

2.17 The loading process commences with the hopper empty and the dredge sailing at a trailing speed of about 1.5 knots. After lowering a long pipe with a suction head (known as the drag head) to the bottom, the vessel commences pumping water at a high rate and drawing material from the seabed. The accelerating water flow mobilises the bottom sediment and a slurry mixture flows into the hopper and settles out. When the hopper is full such that no more sediment will settle out, the loading is deemed to be complete and the vessel lifts its drag arms and navigates to the disposal ground. On arrival at a predetermined position in the disposal ground, it slows to about 1.5 to 2.0 knots and opens its hopper doors to release the load. It then returns to the claim area and commences the cycle again.

2.18 The productivity of the dredger is measured by the number of cycles it can achieve in a week. Clearly, the closer to the disposal ground, the shorter the cycle and the higher the productivity. Conversely, the more distant claim areas (such as the turning basin) involve a longer non-productive time sailing to and from the dump ground. In such situations maximising the payload of the dredger is important.

2.19 To maximise the payload it is necessary to fill the hopper to a maximum level that is determined by an adjustable weir and allow the excess water to overflow. Because of the separation distance between the delivery pipe entering the hopper and the overflow weir, pumped slurry flows slowly through the hopper which allows sediment to settle out. However, the finer fraction of the sediments remains in suspension and returns to the water column in the overflow.

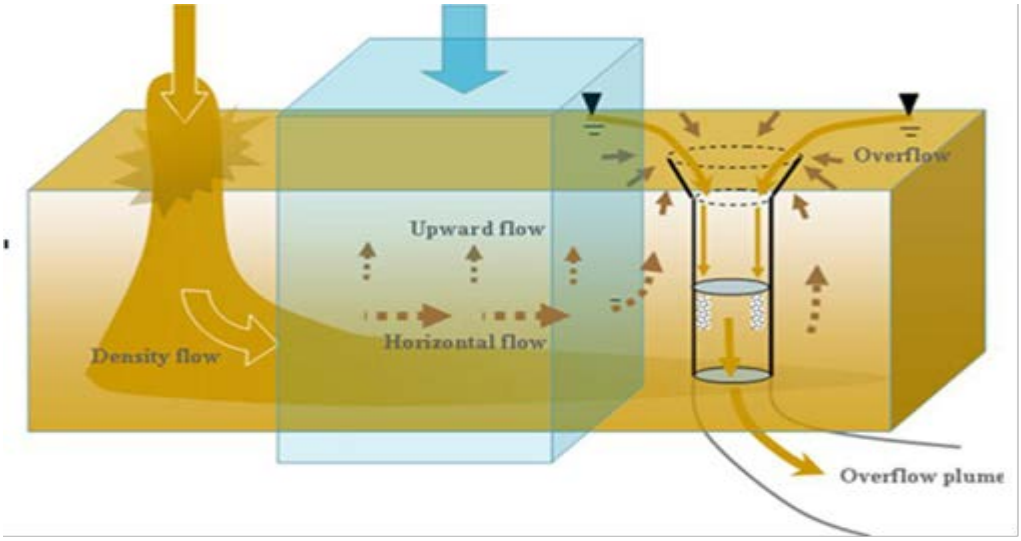


Figure 3: Diagram showing the loading and overflow processes for a dredge hopper (Note the blue section indicates a section of the diagram being modelled for a loading study) source: HR Wallingford.

2.20 The overflow phase continues until no further sediment settles in the hopper. During this time the overflow releases sediment laden water (containing mostly 63 micron sized particles) back into the harbour. The overflow time is therefore a critical determinant of production and also an important measure of the environmental effect of dredging. The release of overflow slurry is to be controlled by a special valve known as a green valve. The flow exits the dredge via a vertical tube with its exit point at the bottom of the hull. Near the top of this tube is a valve that regulates the flow to prevent the entrainment of air into the slurry which causes the plume to be buoyant once released from the hull. With the green valve eliminating this air entrainment, the slurry falls directly to the bottom as a dynamic plume.

2.21 Mr Pronk estimated production for three zones of the harbour and two soil types – soft and firm - in each zone. His zones reflected the average distance of each from the disposal ground. They are the turning basin area, the existing channel and the extended channel including the transition zone. The production rates varied from 388,000 m^3/week in firm soils in the turning-basin area to 716,000 m^3/week in soft soils in the new channel zone. Associated with these production estimates is the cycle time for dredging which ranged from 130 minutes to 225 minutes. While the variation in these ranges arises principally from the sailing distance to and from the disposal grounds, the firmer soils will, if encountered, lengthen the overflow time. It is important to note that despite having a hopper capacity of 17,000 m^3, the maximum payload with these materials is 10,085 m^3. This reflects the fine nature of the sediment being dredged.

2.22 Mr Pronk noted that the overflow time is likely to be 40 to 55 hours per week. Also, in his evidence he estimated the average time to fill the hopper from empty at 22.8 minutes and the total time dredging at 75 minutes. We assumed from this information that a typical overflow time is 52.2minutes/loading cycle.

2.23 Mr Pronk noted that the dredging industry is familiar with the need to mitigate environment effects and he listed the types of actions that could be taken during

dredging to control or mitigate the effects of plumes; these actions being an integral part of an adaptive management programme. He listed the following:

- Changing the location of dredging
- Reducing trailing length
- Altering dredging direction
- Adjusting overflow time
- Adjusting overflow height
- Adjusting water jetting flow velocity
- Adjusting suction flow velocity
- Adjusting the TSHD trailing speed
- Altering the sailing route of the dredger
- Optimising the disposal location within the spoil ground
- Optimising the disposal schedule

2.24 Backhoe dredging: TSHDs are most efficient when removing material over long straight runs. LPC noted that not all the material required to be removed could be excavated with a TSHD. Volumes in the berth pockets close to wharf structures and tight corners, and areas of very stiff clays or rock, need a more flexible type of plant. In such cases a barge mounted backhoe dredge is the appropriate tool. This machine acts in the same way as land based earth moving equipment in that a bucket on the end of a long boom is manoeuvred by hydraulic rams to penetrate and lift soil to the surface where it is deposited in a spoil barge. When the barge is full, it is towed to the disposal ground; in this case either the new Godley Head ground, or if wave conditions are too severe, the existing consented Gollans Bay ground. In response to a question from the Panel, Mr Pronk advised that backhoe dredgers produced very low levels of sediment plumes.

2.25 Maintenance dredging**:** Associated with the capital dredging is the consequential need to provide for the maintenance of the new channel, basins and berth pockets. The application therefore seeks coastal permits to remove seabed materials and dispose of these in a new maintenance dredging spoil ground approximately 3 km east of Godley Head. The new ground which is1.6 km square, is situated just to the north of the outer end of the extended channel. The annual quantity of maintenance dredging is unknown precisely but LPC has indicated that it is likely to be of the order of 900,000 m^3/year.

2.26 The dredger to be employed on this work is a modern TSHD of 1840 m^3 hopper capacity. LPC recognises that despite being relatively close inshore and the new dredger having good sea-keeping ability, conditions at the offshore ground can make opening hopper doors hazardous. LPC therefore proposes to use the existing Gollans Bay ground for a limited volume of 167,000 tonnes (which equates to 100,000 m^3 in

situ) of dredged material as a contingency against adverse operating conditions offshore.

2.27 In its application LPC considered alternatives under three headings; channel dimensions, methods of disposal and location of the disposal grounds.

2.28 The proposed channel dimensions are as outlined earlier. These were determined using a design vessel typical of those that might be used in the future, modern techniques such as ship simulators that mathematically determine the swept path of vessels under a variety of environmental conditions, and guidance from appropriate international channel design guidelines to determine channel width and depth. In this respect the design process was appropriate. However, it was noted in response to a question from the Panel that these dimensions were at a concept stage only, and optimisation is for the final detailed design closer to the execution phases of the project. LPC noted that cost minimisation was a compelling incentive to undertake minimisation.

2.29 Alternative disposal methods were also considered. Land disposal by two different methods was considered; namely trucking material to an inland disposal site and conveying material by pipeline. Both methods involve a high demand on land and the environmental consequences of dewatering such a large volume of material would be considerable. Trucking would involve 2.5 million return trips to dispose of the required volume of material. Selection of an area in reasonable proximity to the harbour would also raise extremely challenging issues.

2.30 Disposal within the harbour to create the reclamation was also considered. This would require the construction of a perimeter bund using imported rock material. While this may be technically feasible, it involves timing issues with respect to the need for the reclamation as well as challenging geotechnical consolidation issues. Some dredged material could possibly be used in the later stages of the reclamation, but to do so now would require the reclamation and the dredging consent to be combined. It was also noted that if this was permitted, the reclamation would not require the entire volume of material to be removed. Using the dredged material for beach nourishment was considered, and rejected, because of the unsuitable nature of the sediment for this purpose.

2.31 The location of the capital dredging disposal grounds was located well outside the harbour balancing the risk of adverse environmental effects reaching the shoreline against the economics of dredging. The chosen site has its nearest point 3.6 km from the coastline and its shallowest point is in a water depth of 18.8m below chart datum. This configuration was arrived at after consideration by the modellers and Manawhenua. This site was then evaluated against a variety of environmental criteria that are considered later in this decision. LPCS's view is that nothing has arisen that calls the location into question.

2.32 For the purposes of maintenance dredging, LPC has proposed a new disposal ground outside the Heads. Two reasons were proffered for this proposal.

- Apparently, there is evidence (not presented in detail) that the use of the existing ground on the northern side of the harbour leads to recirculation of disposed sediments back into the channel.
- Te Hapū o Ngāti Wheke urged LPC to use the largest offshore ground for both capital and maintenance dredging disposal.

2.33 In regard to the first matter LPC believes that recirculation from the existing ground adds to the required maintenance dredging effort and that the use of the proposed ground will limit recirculation to a large extent. In regard to the second matter LPC can see no environmental advantage in using the capital disposal ground but considerable additional cost and operational risk. LPC believes that, in combination, these reasons justify its current proposal. We agree with this conclusion.

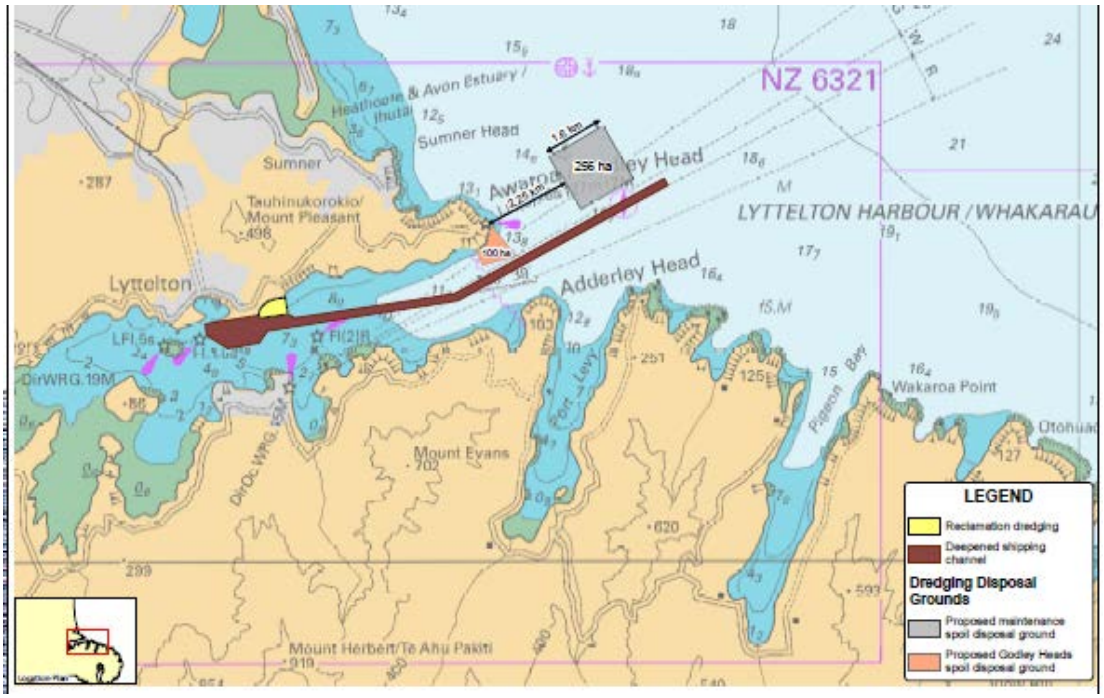


Figure 4: showing the proposed dredged channel and the offshore maintenance spoil ground

2.34 <u>Environmental Monitoring and Management Plan:</u> LPC has formulated an extensive and comprehensive management plan with which to guide and manage any and all aspects of the project that could lead to adverse environmental effects. It was the Cultural Impact Assessment, prepared in 2014 that signalled a strong desire to have the dredging project and its effects managed with an adaptive management framework. LPC undertook to prepare such a plan.

2.35 The preparation of the EMMP commenced in October 2015 with the establishment of a pre-consent Technical Advisory Group (pTAG) consisting of Te Hapū o Ngāti Wheke, Te Rūnanga o Ngāi Tahu, Ngāi Tahu Seafood, Sanford Ltd and LPC. Other technical experts presented at the pTag meetings as required. Over 16 meetings, this group developed the details of the required representation in the plan, the ecological survey methodology, monitoring requirements, both real time and assurance for the

project, and the details of the required adaptive management processes. This work led to the following primary purposes of the EMMP.

a Detail a framework for the management of dredging and disposal plumes

b Detail assurance monitoring to monitor the longer timescale environmental responses to the operation and

c Ensure the effects of the CDP on the coastal environment are within those predicted by modelling and the assessment of environmental effects.

2.36 In support of these purposes a number of primary objectives were developed to:

- Ensure dredging and disposal activities are managed to protect water quality, commercial interests (aquaculture) and the wider community's cultural and recreational interests.
- Specify a framework of adaptive management of the dredging activities based on real time measurement of turbidity and specified management responses
- Detail a program of monitoring of the physical biological and ecological environments of Lyttelton Harbour/Whakaraupō and Port Levy/Koukourārata
- Ensure stakeholder engagement is ongoing throughout all phases of the CDP.

2.37 It is not our intention to discuss here the fine detail of the plan. Suffice it to say that the plan specifies:

- How adaptive management operates in a dredging situation
- How the background turbidity monitoring at carefully positioned monitoring positions surrounding the total work area, are used with the outputs from numerical modelling to develop a series of three trigger levels. These triggers are used as "traffic light" signals to warn the project managers that turbidity levels are increasing above normal background levels and that management action is required. We have included a deeper explanation of these processes in section 7:
- How the trigger levels are determined
- How and where the turbidity monitoring takes place and how the information is collected, quality assured, analysed and made available to the project managers, the dredge operators, and in modified form to the public at large through web access.
- Management responses to the real time data collected.

2.38 In addition to these central controls on the project, the EMMP sets out a number of additional management protocols. These include:

- Dredge Management Plan
- Marine Mammal Management Plan
- Accidental Discovery Plan

- Biosecurity management Plan
- Complaints register
- Incidents register
- Fatalities register

2.39 Finally, the EMMP sets out comprehensive reporting, stakeholder communication and the involvement requirements of the following list of project control groups

- Consent Holder Project Team
- Aquaculture Liaison Group
- Technical Advisory Group
- Peer Review Group

In section 17 we consider the quite complex set of conditions that this project requires. In effect the EMMP is a comprehensive management handbook for the project which documents the processes required to ensure compliance with these conditions and that environmental adverse effects are avoided or mitigated.

3.0 The Receiving Environment

3.1 Here we set out brief description of the harbour and outer Harbour environment for this activity to provide information that will assist in understanding the broad range of impacts of the proposal. In its application LPC provided a wealth of information on Banks Peninsular, Lyttelton Harbour/Whakaraupō, Pegasus Bay and Port Levy/Koukourārata which we will not attempt to summarise. Rather we will set out sufficient information to assist the understanding of our decision.

3.2 The Physical Setting: Lyttelton Harbour/Whakaraupō is an eroded, enlarged remnant of an extinct and drowned volcano. The Harbour is aligned approximately east/west, 15km long and 2 km wide. The valley walls are generally steep, rocky and descend well below the harbour bottom. The valley has been filled over geological time with fine windblown sediment (Loess) which has formed a thick (greater than 40m) layer with a very flat surface forming the bed of the harbour. Deforestation added to the sedimentation layer brought about by run off from the surrounding slopes. The longitudinal slope of the seabed from the head of the harbour to the entrance is approximately 1:1000. The natural depth at the entrance is approximately 14 m below chart datum.

3.3 The Port of Lyttelton is located approximately halfway along the harbour on the northern side. It is formed in a natural embayment supplemented by reclamation forming an enclosed inner harbour in which a series of 6 piers, and two shore parallel wharf structures form cargo transfer facilities. Much of this inner harbour is now obsolete, and in the process of being replaced by modern berths to the east of the inner harbour basin. A modern berth structure, known as Cashin Quay is backed by

a reclamation. A short breakwater at the far eastern end provides wave shelter to Cashin Quay.

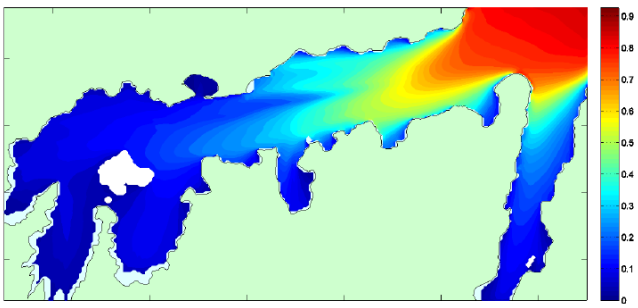
Figure 2 Aerial view of Port Lyttelton/Whakaraupō showing the port on the northern side. Port Levy/Koukourārata is the inlet south east of the main harbour entrance.

Immediately adjacent to Cashin Quay is a ship turning basin at the head of an existing dredged channel. The depth of these features is 12.2 m below chart datum. The channel is approximately 175 m in width and 7500 m in length. The natural depth of the area opposite the harbour basin and Cashin Quay is approximately 6.0m

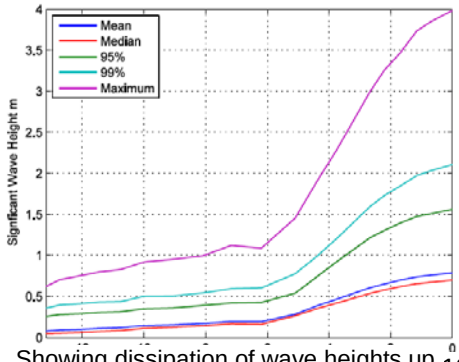
3.4 Maintenance dredging occurs annually to maintain the required navigational dimensions of this channel. The quantities of maintenance dredging vary between 300,000 and 600,000 m^3/year.

The Hydraulic Environment

3.5 Waves: Waves in the harbour result from two sources. Local wind generated waves and swell that penetrates the harbour from the open ocean. In general terms, swell waves have periods between 7 and 25 seconds. Wind waves have periods less than 7 seconds. LPC commissioned Dr Derek Goring of Mulgor Consulting Ltd to prepare a report on the effect of the proposed dredging on the waves and tidal currents in Lyttelton Harbour/Whakaraupō. In this report Dr Goring describes the wave climate in the existing harbour from 10 years of record. The outcome of this exercise is shown in the two figures below.



Distribution of mean significant wave height in Lyttelton Harbour/Whakaraupō and Port Levy/Koukourārata



Showing dissipation of wave heights up the Harbour

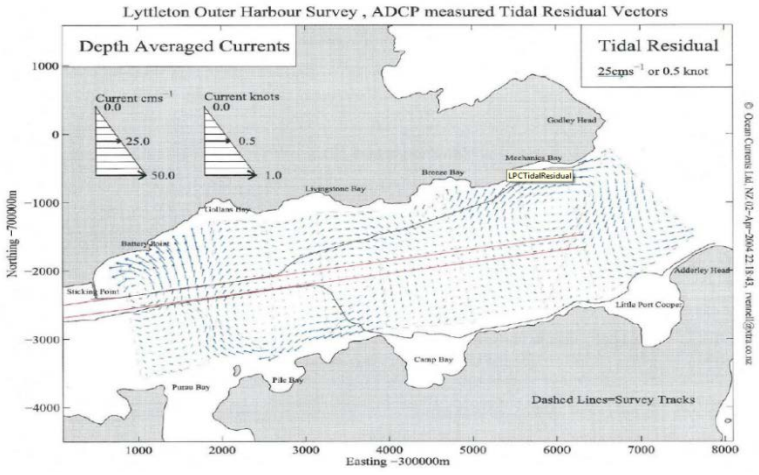
3.6 These figures illustrate the way wave heights vary with distance from the harbour entrance. The figure on the left is showing the distribution of the mean significant wave heights throughout the harbour. The figure on the right illustrates how the wave heights dissipate with distance from the entrance. It can be seen that the swell energy entering the harbour from the ocean tends to dissipate quickly and rarely penetrates deep into the harbour. Major storm events can result in total significant wave heights close to the port of the order of 2.0 m. However, these are relatively rare events.

3.7 Waves offshore: Wave data obtained by MetOcean Solutions indicates that at the dump ground waves predominantly arrive from the east to NE quadrant with a significant wave height of 0.987 m at the centre of the ground and 1.12 m at its eastern boundary.

3.8 Tides: The incoming (flood) and outgoing (ebb) tides generate small currents up and down the harbour. The values of the speed of spring tide flood currents are of the order of 0.3m/sec except in locations adjacent to Cashin quay and the Naval Point breakwaters and in the shallow zone around Quail Island, where speed reach values close to 0.5 m/sec. A similar pattern is evident for ebb currents. The important point in relation to this project is that tidal currents are the dominant mechanism that will move plumes, they are low in magnitude and confined to alignment within the channel.

3.9 Seiches: These are long period (in this case 3- 4 hr) oscillations of Pegasus Bay brought about by storm events that migrate into the harbour. The contribution of this phenomena to currents is relatively significant, but of the order of less than 0.01 m/sec. Throughout most of the harbour, tidal currents are fairly symmetrical in that, over a tidal cycle, a neutrally buoyant particle will return very close to its initial position. Investigations have also shown the excursion of such particles throughout a tidal cycle is limited and as a result the harbour is divided into three compartments. The presence of these compartments means that the upper harbour is relatively isolated hydraulically from the lower harbour and sediment exchange does not take place between them. A degree of asymmetry in tidal flows does exist and this allows gradual exchange of water throughout the inlet.

3.10 At the entrance, tidal currents flow into and out of the harbour asymmetrically. This results in residual current eddies as shown in the diagram below. Residual currents are important indicators of net sediment transport vectors.



3.11 In the offshore zone in the vicinity of the disposal grounds tidal currents were measured over a 67 day period and the mean currents were shown to be elliptical with the major axis speed being 0.1m/s in an ESE-WSW direction. The minor axis speed was 0.048 m/s. This represented between 60 -70% of the current energy at the site.

3.12 The Sedimentary Environment: The bed of Lyttelton Harbour/Whakaraupō consists of a deep (greater than 40 m) unit of fine sediment. The particle size description of this material is described by Mr GaryTeear of OCEL in the following way:

Fine sand (0.25 to 0.05 mm)	1%
Silt (0.05 to 0.005 mm)	45%
Clay (smaller than 0.005mm)	54%

3.13 Dr Beamsley of MetOcean Solutions described the distribution differently (see table below) for the purpose of modelling and added to his description the property of fall velocity which reflects the speed at which particles settle in still water**.**

	Representative d_{50} [microns]	**Settling Velocity [m/s]**	**Percentage of total volume [%]**
Class 1	Smaller than 44	0.0010	81.8
Class 2	44.0	0.0014	7.0
Class 3	62.5	0.0028	5.3
Class 4	118	0.0085	5.9

This table clearly demonstrates the potential for plume formation from this material.

3.14 Preliminary borehole records indicate that the depth of these sediments extends far below the proposed dredged depth and the spatial extent of them is consistent throughout the area of the harbour being dredged.

3.15 Mr Teear and Mr Goring both refer to the existence of a fluid mud layer in the harbour and in Pegasus Bay. This very fluid layer is caused by the almost continual action of waves on the seabed which readily lift this fine material into suspension. The suspended layer appears to vary in depth from 5 to 7 cm inside the harbour, 10 to 17 cm at the entrance and up to 45 cm in the channel opposite the disposal grounds on the north side of the harbour. Outside the harbour at the offshore disposal ground this layer is approximately 24 cm deep.

3.16 Turbidity: Mr Teear has an extensive discussion on turbidity in his report in Appendix 8 of the application. In this he notes that:

"The coastal water of Pegasus Bay and Lyttelton Harbour exhibit high natural variability in their characteristic properties. There are substantial variations in turbidity

day to day, variations attributable directly to natural causes – high energy sea-state events and river flood discharges……..The key point is that this variability is natural and any turbidity induced by dredging will not produce an isolated spike in constant background turbidity level totally at variance with what occurs as a natural process.". Elsewhere it is similarly noted that the marine biota in the harbour have evolved to survive in this highly variable and highly turbid environment.

3.17 The biological setting: Extensive work has been undertaken to describe and characterise the biological setting of this application. This is recorded in reports from Cawthron Institute by Mr Ross Sneddon and from Boffa Miskell. Cawthron dealt with marine ecological resources (Application Appendix 15A) and effects on Marine Mammals (Appendix 16). Boffa Miskell addresses marine avifauna (Appendix 17)

3.18 The overall picture of the harbour is that its bed is a muddy bottom in which benthic communities are limited in type and abundance. Benthic communities are comparatively sparse with low richness with a numerical prevalence of polychaete taxa as well as taxa such as ostracods, crabs and cumaceans. This is also true of the bed of the disposal grounds in Pegasus Bay.

3.19 The higher value communities exist along the edges of the harbour in subtidal and intertidal habitats where wave activity in the shallows agitates water and keeps fine sediments in suspension, so that settlement tends to occur in deeper water offshore.

3.20 The shallow subtidal reefs are dominated by giant kelp and the common kelp and in places bull kelp. A variety of other taxa occur including bryozoans, mussels, ascidians and sponges. Pāua, topshell and turbinid are also abundant, while sea urchins have been recorded in depths of 3- 5 m. Finfish in this zone include banded wrasse, spotties and leatherjackets

3.21 The intertidal zones are characterised by abundant tubeworms and barnacles as well as periwinkles, limpets, oyster oysters and cat's eye snails in the upper shoreline zone. The low shore areas are characterised by taxa in the mid-shore zone although sponges and tunicates begin to occur and the diversity of algae increases.

3.22 Hector's dolphin is the most notable marine mammal of the area. A Banks Peninsula marine mammal sanctuary extends from the Waipara river north of the Peninsula to the Rakaia river south of the Peninsula, and extending 12 nautical miles offshore. In addition there is a total ban on set netting in specified areas of Banks Peninsular.

3.23 Southern right and hump back wales are notable seasonal visitors to the area offshore of the Peninsular. Small populations of fur seal can be found on many of the Peninsular headlands.

3.24 Lyttelton harbour and the surrounding coastline provides a diversity of habitat types for marine avifauna for nesting and foraging.

3.25 Aquaculture: Aquaculture is a major industry in Banks Peninsula. There are 24 active resource consents held by 5 different consent holders. Consents have been awarded

for the growing of a number of species including green shell mussels, blue shell mussels. Algae and for the collection of mussel spat. While the growing of all these species is permitted, the only commercial activity undertaken to date is the growing of green shell mussels and the collection of green shell mussel spat.

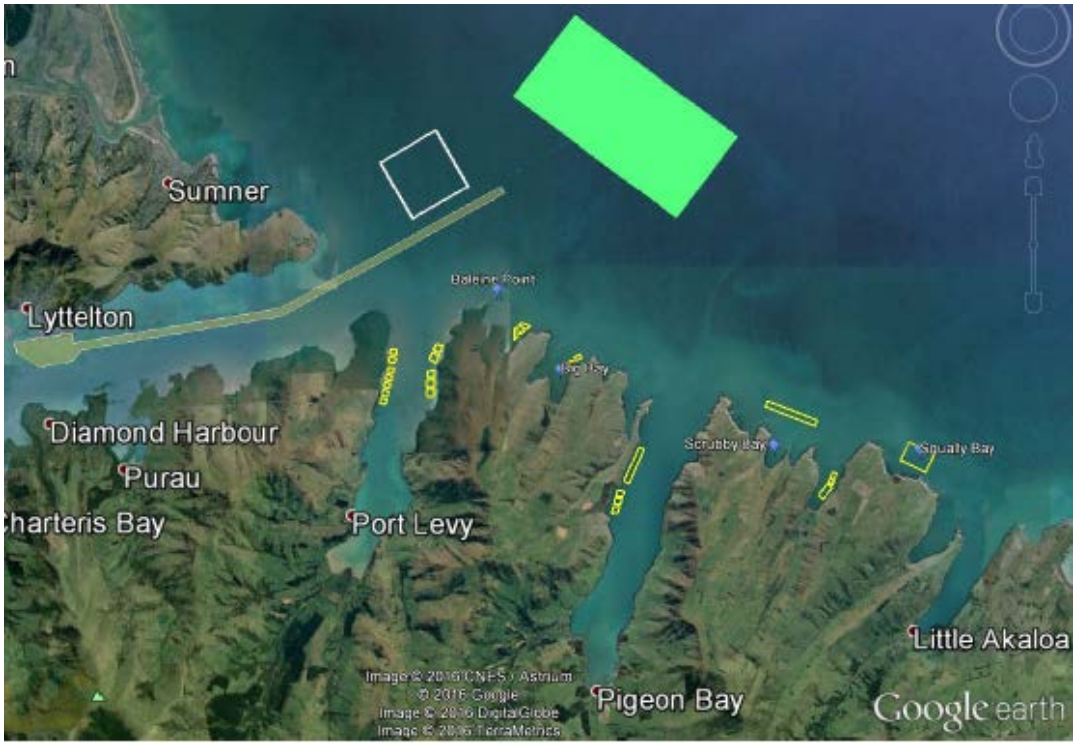


Figure 3: Site location map showing existing marine farm sites (yellow open polygons) along the northern side of the Banks Peninsula, the approximate proposed dredge area (yellow closed polygon), the proposed offshore capital dredge disposal ground (green polygon) and the proposed new maintenance disposal ground (white open polygon).

3.26 Tonkin and Taylor in Appendix 6 to the application reported that there are around 123 ha of mussel farms on the northern side of the peninsula. Advice received from the industry that the capital value of for each hectare ranges from $125,000 to $200,000.The estimated permit value of the farms ranges between $15,375,000 and $24,600,000. In addition, each longline structure has a capital value of $15,000 and there are 297 visible longlines which adds a further $4,455,000. The estimated capital value of the mussel farms is between $19,830,000 and $29,055,000.

3.27 Tonkin and Taylor further report that over the last 6 financial years, mussel production averaged 2000 tonnes per annum from the farms. The average market value in 2015 was $3,190/tonne giving an estimated gross production value of $6,382,000.

4.0 The Legal Framework

4.1 The RMA and the Resource Management (Marine Pollution) Regulations 1998 provide the statutory framework under which the application is to be assessed. But it is also helpful to refer to the Lyttelton Port Recovery Plan, and two policy statements

of relevance to the case of Sustain Our Sounds Inc. v New Zealand King Salmon Company Limited[1], a Supreme Court decision which stipulates how the suitability of a proposed adaptive management regime should be assessed.

4.2 Section 12 of the RMA relevantly provides:

"(1) No person may, in the coastal marine area,

(c) Disturb any foreshore or seabed (including by excavating, …….) in a manner that has or is likely to have an adverse effect on the …. seabed ……..;

(d) Deposit….. on any …. seabed any substance in a manner that has or is likely to have an adverse effect on the ….. seabed;

unless expressly allowed by …….. a resource consent.

These subsections appear apt to capture both dredging and soil disposal offshore. However, subsection (6) provides that section 12 "shall not apply to anything to which section 15A or 15B applies."

4.3 Section 15A relevantly provides:

"(1) No person may, in the coastal marine area,

(a) dump any waste or other matter from any ship,…….unless the dumping ……. is expressly allowed by a resource consent."

Waste is widely defined as "material and substances of any kind, form or description". Hence, it appears that in relation to spoil dumping s15A(1)(a) prevails and applies, while s12(1)(c) applies to dredging. One way or another it is clear that both activities require a resource consent.

4.4 Section 4(2) of the Resource Management (Marine Pollution) Regulations, 1998, is specific in providing that "in the coastal marine area the dumping of waste…. from any ship… is deemed to be a discretionary activity in any regional coastal plan…", and "dredge material" is item (a) on the list which defines waste. It is common ground that this discretionary status, although only deemed applicable to the two spoil dumping permits, results in the two dredging permits being discretionary activities as well. This outcome follows from the obvious linkage between the two activities of dumping and dredging, upon application of the principle of bundling.

4.5 <u>The Lyttelton Port Recovery Plan</u>: Channel deepening is an integral component of the Lyttelton Port Recovery Plan. This Plan was gazetted by the then Minister for Canterbury Earthquake Recovery in November 2015. The third of several key considerations that underpin the Plan is expressed as follows:

"To accommodate larger ships, Lyttelton Port requires deeper and longer shipping channels. If Lyttelton Port is only serviced by relatively small, old

[1] Sustain Our Sounds v King Salmon [2014] NZSC 40

and costly ships, it could disadvantage Christchurch and Canterbury in terms of economic efficiency and growth.

Lyttelton Port Limited is seeking to deepen and widen the main navigational channel and to create and deepen ship-turning basins adjacent to Te Awaparahi and Cashin Quay reclamations."

Other key objectives of the Plan are the repair and rebuild of harbour infrastructure, completion of the Te Awaparahi Bay reclamation and the construction of a container terminal on the reclamation. The reclamation, container terminal and the channel deepening projects are inextricably interlinked components of the objective to make the Port big ship capable.

4.6 The Plan also directed the inclusion of a new Chapter 10 in the Canterbury Regional Coastal Environment Plan. The key objective in Chapter 10 is to expedite recovery of the Port, while policies seek to enable each of the component parts of the Plan including: channel deepening using best practice methods (policy 10.1.8), and spoil deposition at offshore grounds provided adverse effects are both monitored and managed (10.1.9). The Minister also extended the operational area of the Port to include the area of the new channel given its widened and lengthened footprint. But the operational area was not extended to include the proposed offshore spoil dumping grounds.

4.7 The Recovery Plan has special significance in a resource consent context by virtue of a provision in the Greater Christchurch Regeneration Act 2016. This Act replaced the Canterbury Earthquake Recovery Act 2011 upon its expiry date. Section 60(2) of the replacement Act provides that any person deciding a resource consent application "must not make a decision or recommendation ….that is inconsistent with the Plan…" Should a council, or LPC, consider that this has occurred, they may request the Minister to rule upon the matter or appeal to the Environment Court (s.s 60(3) and (4), respectively.)

4.8 Two Policy Statements: Before considering the King Salmon case there are two potentially relevant policies that require mention. Policy 3 in the New Zealand Coastal Policy Statement 2010 requires that people:

"(1) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse."

The Canterbury Regional Policy Statement includes Policy 6.1 that relevantly states:

"Within the Coastal Marine Area Environment Canterbury will:

(iii) adopt a precautionary approach when considering applications for resource consents where the effects, including cumulative effects, are as yet unknown or little understood, or where the functioning of marine ecosystems and coastal processes is poorly understood.

Despite the similarity of the language in these policies there is one subtle difference. The National policy stipulates a precautionary approach only if the effects are "potentially significantly adverse", whereas the Canterbury provision has no caveat relating to the seriousness of the potential effects. In this regard the Canterbury policy is more far-reaching; a precautionary approach is required where there are adverse effects, regardless of their degree.

4.9 The King Salmon decision: This is the leading New Zealand authority on adaptive management. King Salmon obtained consent to establish additional salmon farms in the Marlborough Sounds. The major environmental issue was whether salmon feed levels would compromise water quality as a result of increased nitrogen levels and potentially give rise to an ecological disaster. Consent was granted upon terms that required: staged development of the farms, dependant on quality standards being met as measured through a tiered monitoring system, and with prescribed management responses to ensure the farms remained compliant. Save the Sounds, an incorporated society of interested environmentalists, appealed against the consent decision on the basis that insufficient baseline information existed, modelling of the effects of increased feed discharge on water quality was flawed, including because the potential maximum feed level had not been modelled at all.

4.10 The Supreme Court considered the concept of adaptive management in detail and by reference to New Zealand, Australian and Canadian authorities. Central to its analysis was the need for the adaptive regime to meet the requirements of the New Zealand Coastal Policy on adoption of a precautionary approach (see 4.8), and the Marlborough regional policy as well. The Court at [113] noted commentary to guidelines promulgated by the International Union for Conservation of Nature (IUCN) in 2007, namely that an adaptive management approach is:

> "particularly useful in the implementation of the Precautionary Principle as it does not necessarily require having a high level of certainty about the impact of management measures before taking action, but involves taking such measures in the face of uncertainty, as part of a rigorously planned and controlled trial, with careful monitoring and periodic review to provide feedback, allowing amendment of decisions in the light of such feedback and new information."

4.11 In assessing whether an adaptive management approach was appropriate in the King Salmon case the Court identified two questions that must be considered:

> "As to the threshold question of whether an adaptive management regime can even be considered, there must be an adequate evidential foundation to have reasonable assurance that the adaptive management approach will achieve its goals of sufficiently reducing uncertainty and adequately managing any remaining risk."[2]

[2] At [125]

4.12 The Court then formulated a second question centred upon the precautionary principle; namely the need to determine whether the activity should "be prohibited until further information is available", or was the proposed "adaptive management regime (to) be considered consistent with a precautionary approach" (at [129] of the judgement.) This, the Court said will depend:

"……. on an assessment of a combination of factors:

(a) the extent of the environmental risk (including the gravity of the consequences if the risk is realised);

(b) the importance of the activity (which could in some circumstances be an activity it is hoped will protect the environment);

(c) the degree of uncertainty; and

(d) the extent to which an adaptive management approach will sufficiently diminish the risk and the uncertainty."

In due course we will evaluate the proposed LPC adaptive management regime with reference to these two questions.

5.0 Assessment of Effects: The Structure of the Decision

5.1 The assessment of effects provided in support of the application began with an examination of the benefits anticipated from deepening the channel, being significant economic gains. This was followed by an assessment structured largely on the principal causes of effects: the channel footprint, waves, currents, plumes, spoil deposition, and spoil erosion. These causal influences were each considered with reference to the ecological risk they each posed. Finally, the effects on manawhenua rights, values and interests were assessed.

5.2 Our approach will be somewhat different. We will also begin with an assessment of benefits. This was not a contentious aspect. There was virtually no challenge to LPC's claim that the project focus is on increasing the capacity of the Port and that this has the potential to benefit Christchurch and the Canterbury Region as a whole.

5.3 We shall then consider the causes of the effects in this case, but through the lens of the adaptive management regime proposed by LPC to safeguard against adverse effects. This will require a close examination of the proposed monitoring system; the hydrodynamic modelling process undertaken to date in an endeavour to predict the likely impact of dredging and spoil disposal; and the adaptive management proposals intended to provide a check upon dredge-related activities and thereby protection against adverse effects. The proposed adaptive management regime is the centre piece of this application. It proved to be complex, contentious and challenging; not the least on account of the volume of, and disagreements concerning, expert evidence. Our evaluation of monitoring, and the modelling process and results, will necessarily

expose how the project activities will cause effects both in and outside the Harbour whether to turbidity, the wave climate or the seabed itself.

5.4 This will provide the causal background to then examine those areas where there is potential for adverse effects to be felt. Eight areas will be considered, from coastal processes to benthic, reef and shoreline ecology, and to recreational use of the Harbour, including surfing.

5.5 Last but not least we shall evaluate manawhenua concerns. It is best to do this after all other potential effects have been considered, since issues of concern to Ngāi Tahu are all encompassing. Their submission was made on behalf of four entities: Te Hapū o Ngāti Wheke based in the Upper Harbour at Rapaki, Te Rūnanga o Koukourārata (Port Levy), Ngāi Tahu Seafood Ltd and Te Rūnanga o Ngāi Tahu. It expressed through a number of witnesses, both lay and expert, a wide range of concerns, including: that Whakaraupō was once a bountiful source of mahinga kai but is now degraded, this further LPC project will subject the Harbour to an environmental insult resulting in an enlarged scar running from the Port out to sea; the impact of this on the Harbour has not been adequately assessed; the proposed adaptive management regime is deficient on account of inadequate monitoring and defective modelling; and that the application should only be granted if conditions are imposed that ensure a net gain in mahinga kai is achievable and Ngāi Tahu can exercise kaitiakitanga over Whakaraupō in partnership with LPC.

5.6 The final sections of the decision will contain our conclusions and decision on the application. This will include an assessment of the conditions as proposed and then refined in light of developments throughout the formulation, and hearing, of the application.

6.0 Economic Benefit

6.1 The Lyttelton Port Company: LPC, is owned by Christchurch City Council Holdings Ltd on behalf of the Christchurch City Council. It owns and operates the Port of Lyttelton. The Port land area is 149ha extending from Magazine to Gollans Bay. In addition the Company owns and operates container facilities located at Woolston and Rolleston. The Port business operates on a 24 hour, 7 day, basis and provides over 500 jobs. Like other New Zealand ports, Lyttelton is under a statutory obligation to "operate as a successful business". [3]

6.2 Lyttelton is the largest and most significant port in the South Island in terms of the tonnage of cargo and number of containers handled, as well as the total value of exports and imports. It is the third largest port in the country handling over 15% of New Zealand's imports and exports. In 2015 exports through the Port totalled $4,568 million in value, being 9% of New Zealand's total exports. Imports totalled $4,001 million, 7.8% of the New Zealand total. In the financial year ended June 2015 LPC

[3] Section 5, Port Companies Act 1998.

received revenue of $109.1m, paid $48.5m in salaries and wages and spent $30.4m on goods and services. These figures provide some indication of the Port's commercial significance to the Canterbury economy.

6.3 Policy Statements: National and regional policy statements demonstrate the importance of the Port. The New Zealand Coastal Policy Statement, 2010, objective 6 recognises that some "uses" in the coastal environment "are important to economic wellbeing", and moreover that some economic drivers "can only be located … in the coastal marine area." Policy 6(2)(c), facilitates objective 6 by providing that economically significant activities need to be appropriately placed within the coastal marine area.

6.4 The Canterbury Regional Policy Statement defines "strategic infrastructure" and "strategic transport network", and names Lyttelton Port as an activity falling within both these definitions. Policy 8.3.6 provides that regionally significant infrastructure in the coastal environment should be provided for in relation to "operation, maintenance and upgrade"; with "reverse sensitivity effects…avoided"; and the recovery of Lyttelton Port "expedited….including its repair, rebuild and reconfiguration".

6.5 This theme of Port recovery was further advanced through the introduction of a new Chapter 10 in the Regional Coastal Environment Plan (for the Canterbury Region). The earlier discussion at 4.15 – 4.7 refers to some key aspects of these recovery provisions. In addition policy 10.1.2 recognises that the Port is "essential" to both the regional economy, and the recovery of greater Christchurch. This group of enabling provisions is, however, counter-balanced by policy 10.1.4 which recognises that recovery will result in "some adverse effects on the environment" and imposes on LPC an obligation to ensure:

> "(1) The relationship between Lyttelton Port and the values of Whakaraupō/Lyttelton Harbour are recognised; and
>
> (2) Any adverse effects on the ecological, recreational heritage, amenity and cultural values of Whakaraupō/Lyttelton Harbour are minimised as far as practicable; and
>
> (3) Best practice methods are used during construction; and
>
> (4) Effort is made to achieve a net gain in mahinga kai."

Those obligations will be relevant to the assessment of adverse effects and will feature in later parts of the decision. Likewise objectives and policies in earlier chapters of the Plan recognise the need to protect various areas, ecological species and places of special significance; which provisions will also be relevant to our evaluation of ecological effects.

6.6 Big ship capability: This concept provides the rationale for the channel deepening project. While the Port is already recognised for its significance to the region as a

transportation hub, LPC seeks to increase its shipping capability and thereby at least maintain its current national status as the leading South Island port. Capability to receive and service larger container ships is seen as essential to this aim.

6.7 Over recent decades there has been a global trend towards container usage, larger vessels and fewer port calls. There are economies of scale at play; attributable to fuel efficiency and increased container volumes resulting from a switch to bigger ships. Mr Michael Copeland, an economist retained by LPC, cited a report obtained by the Ministry of Transport entitled "Future Freight Scenarios Study."[4] It contained an assessment of the potential benefits from Lyttelton becoming a big ship capable hub, being a saving of more than 10% in freight costs for Canterbury and West Coast customers. The cost of not doing so led to a predicted increase in freight costs of 11 to 50% for Canterbury and even more for West Coast customers.

6.8 The ships presently servicing New Zealand ports have a capacity of 2,700 to 4,100 TEU's (twenty- foot equivalent units). Big ship capability requires a vessel size of 7,000, probably increasing to 10,000 TEU's over time. This so-called "New Panamax" class of vessel requires a draught of 14.5m to provide safe passage during all tide conditions; hence the need to deepen the channel by between 4.65 to 5.65m. In 2010 the New Zealand Shippers Council issued a report[5] on New Panamax port capacity, in which the Council concluded that the four major ports (Auckland, Tauranga, Lyttelton and Otago) should plan for New Panamax capacity, but that Tauranga and Lyttelton should be first in line.

6.9 In relation to Lyttelton this conclusion reflected that it is by far the largest South Island container port, is best located to become a hub to other ports and that its development costs to achieve increased capability are expected to be lower. Lyttelton has experienced exponential growth in container numbers (a 10 fold increase in 30 years) and this trend is projected to continue (to 1 million TEU's per annum by 2041.) Mr Copeland emphasised New Zealand's reliance on overseas trade and sea transport. New Zealand ports handle 1% of the annual global container throughput, yet our population represents only 0.06% of the world's population. And, given our size and location, a dependence on trade is bound to continue.

6.10 That said, LPC's approach to big ship and sea transportation capability is based on phased development. It envisages at least two stages of channel deepening separated by a period of years. This will provide the flexibility to match Port capacity with market demand, given that projecting container volumes into the future is necessarily inexact.

6.11 Submissions and conclusions: As mentioned in the introduction submitters largely accepted the business and economic rationale that underpins the application. We are in no doubt that LPC's development project will promote the social and economic wellbeing of individuals and communities located in the Canterbury region, and

[4] Prepared by Deloittes, November 2014

[5] "The Question of Bigger Ships: Securing New Zealand's International Supply Chain", August 2010

beyond. Accordingly, we accept that the economic imperative is a powerful consideration that lends considerable weight to LPC's application.

7.0 Adaptive Management of Dredging and Disposal Plumes

7.1 LPC's proposal to deepen the navigation channel necessitated three distinct but interrelated lines of inquiry. These were how to:

- best monitor water quality, and in particular sediment plumes generated by dredging and spoil disposal,
- predict the likely extent and distribution of the plumes using hydrodynamic modelling, and
- manage dredging and disposal activities to avoid or mitigate adverse environmental effects using an adaptive management regime.

We shall evaluate each aspect in turn.

Water Quality

7.2 Monitoring. Vision Environment Australia Pty. Ltd. was retained to advise in relation to water quality monitoring. Ms Leonie Anderson, a director of the Company, assumed responsibility for the project. She holds a Master of Applied Science degree, and has acted as project manager for the environmental monitoring of numerous projects, including several large scale dredging projects which use an adaptive management approach. In 2016 she joined the technical advisory group (TAG), thereafter attended many of its meetings and acquired an in-depth understanding of the LPC project.

7.3 Baseline monitoring of the Harbour waters was the first step. Such monitoring over a 12 month period was required to provide an understanding of the ambient or background environmental conditions. Ms Anderson designed and provided a brief that described the monitoring parameters, the sites at which monitoring would occur and the field instruments to be used.

7.4 Parameters are the natural conditions that are to be monitoring over the 12 month baseline period, and beyond. In this case the dominant issue is water clarity, commonly referred to as turbidity (cloudiness) caused by the suspension of fine sediment in the water of the Harbour. As noted earlier the Harbour is naturally turbid to some degree, the level of turbidity being affected by atmospheric, weather and sea conditions, on a daily basis. Hence there was a need for baseline monitoring to establish a comprehensive data-set of the Harbour's natural turbidity fluctuations, absent dredging activity. Without this there would not be a basis for a before and after evaluation of the turbidity effects caused by dredging, nor the ability to adaptively manage dredging activity to safeguard flora and fauna.

7.5 Another parameter, or indicator, being monitored is the water chemistry; namely its acidity, temperature, conductivity and dissolved oxygen concentration. This type of information is helpful in judging whether environmental effects are not dredge-

related, and whether a turbidity change is attributable to a natural event such as a large flood from a nearby river.

7.6 Other parameters monitored include water currents (both speed and direction), wind and waves, nutrients and contaminants (both metallic and organic.) Metal contaminants may be disturbed during dredging while organic ones are typically herbicides or pesticides that have found their way into the sea. The level and frequency of monitoring varies depending on the relative importance of the indicator in the overall context of this project.

7.7 Monitoring Sites: The locations at which testing occurs; and samples are taken, is of considerable importance. The location of dredging activity and of the spoil disposal grounds, the relative location of shoreline colonies, and the dictates of adaptive management must all be considered. Ms Anderson concluded that impact, management and reference sites were needed. The former are positioned to test the impact of spoil dumping in particular, while management or "sentinel" sites warn of the spread of sediment plumes so that management action may be initiated, and a single reference site provides comprehensive comparative information from a more distant location. The location of 15 monitoring sites, one of which doubles with a weather station (SG2 a, and b,), are depicted below

7.8 The symbol SG is used for sites adjacent to the main spoil ground, OS for offshore, CH for central harbour and UH for upper harbour sites. The colour of the spot marking each site identifies the type of monitoring instrument, with two colour spots used where there are two types of instruments. Conditions proposed by LPC stipulate the

minimum number of monitoring sites according to zone; being the channel, inshore, offshore and spoil ground zones.

7.9 Field Instruments: An array of instruments have been deployed. The various types are both marked on the site map above and more fully described in the table taken from Ms Anderson's report and reproduced below:

Table 1 Summary of monitoring sites and deployment equipment for the LPC Channel Deepening Project.
ST = subsurface telemetry, SL = self-logger, BSL = benthic self-logger, BPAR = benthic photosynthetically active radiation, and ADCP = Acoustic Doppler Current Profiler, WK = WatchKeeper telemetered weather station.

Site	WK	ST/ADCP	ST	BSL sonde	BSL sonde/BPAR	Altimeter
	WatchKeeper telemetered weather station with currents and waves	Subsurface telemetered dual physico-chemistry and currents	Subsurface telemetered dual physico-chemistry	Benthic self-logging dual physico-chemistry	Benthic self-logging dual physico-chemistry and self-logging BPAR	Benthic self-logging dual altimeter
SG2a	√					
SG2b			√			
SG1		√				
SG3		√				
OS1			√	√		
OS2			√		√	√
OS3			√		√	
OS4			√		√	
OS5			√			
OS6			√	√		
OS7			√			
CH1			√			
CH2			√			
UH1			√			
UH2			√			
UH3						√
Total	1	2	12	2	3	2

7.10 Referring to each of the above instrument columns WK stands for WatchKeeper a solar powered marine buoy housing a real time ocean and weather system that provides data including wind speed and direction; air temperature and humidity; barometric pressure; and sea surface temperature and conductivity. Also installed on the buoy is a current profiler that measures wave direction, height and period; as well as current speed and direction. The real time data is transmitted every 15 minutes through a phone network service provider to VECLoud, a data warehouse run by Vision Environment in Gladstone, Queensland.

7.11 ST refers to subsurface telemetered data loggers, two of which are deployed together affixed to a buoy. Having two loggers guards against data loss should one unit

malfunction. The loggers record and transmit water chemistry data, including turbidity measured in NTU. At two sites (SG1 and SG3) the dual data loggers are deployed with current profilers (ADCPs) that function as described above. Otherwise, at 12 sites dual water chemistry loggers are deployed at a depth on 0.75m (without a current profiler) and likewise transmit data to VECloud at 15 minute intervals.

7.12 BSL sonde refers to further dual water chemistry loggers, but these are fixed to a benthic (seabed) frame which, when lowered, positions the units about 1m above the seabed. The loggers provide the same spread of data as the surface units and on a continuous basis, but the data indicates what is happening at the near seabed level. At three sites (OS2, OS3 and OS4) the dual water chemistry loggers are paired with a benthic photosynthetic active radiation (BPAR) logger. These log the mean ambient light intensity near the seabed over one minute at 15 minute intervals. This provides a basis for benthic turbidity levels to be measured after account has been taken of the prevailing cloud cover on the day.

7.13 Finally, at sites adjacent to the entry to Port Levy (OS2) and near Rapaki (UH3) dual altimeter instruments have been deployed mounted on benthic frames. These provide continuous seabed level measurements at a high level of precision. Acoustic measurements are taken over one minute internals every 15 minutes. This enables sediment flux to be understood, both in real time and over a given period. Changes in seabed levels at these sites will help clarify whether dredging spoil is affecting the Port Levy and Upper Harbour areas.

7.14 Manual Water Sampling: The report written by Ms Anderson and filed in support of LPC's applications included a comprehensive section on manual water sampling that is undertaken at the 15 monitoring sites to complement the electronic testing regime. This includes monthly depth profiling at different levels to establish light attenuation at increasing depths; water density testing at various depth levels in relation to a range of metals and nutrients; and subsurface, mid-column and benthic water sampling to enable total suspended sediment concentrations (TSS) to be determined – a cross-check on turbidity. Further, sub-surface samples are to be taken bi-annually to test for organics, including hydrocarbons pesticides and herbicides.

7.15 The samples are tested at accredited laboratories and the results have added significantly to the understanding of water chemical changes in the Harbour. Depth profiling has shown that there is no evidence of stratification of the water column. This means that plumes from dredging activity can be expected to mix into the water column and be detected at surface sites.

7.16 Monitoring Progress to Date. Ms Anderson in evidence stated that monitoring commenced in August 2016, a full roll-out of instruments was achieved by November 2016 and that baseline testing would continue until August 2017. Based on her experience in relation to comparable Australian projects she expressed confidence in the results to date, the suitability of the monitoring sites and the efficacy of the methods adopted.

7.17 She also outlined how real time data will be received by VECloud, the database system in Gladstone; and then processed and made available to LPC and in due course to the public. This is a sophisticated system. LPC has access to a designated viewing platform that personnel can visit at any time. The platform displays a map of the Harbour and the immediate offshore area, with the individual monitoring sites identified by location and their specific number. Each site is colour coded ordinarily green, but this will change to an alert colour should an event occur. Users of the platform can examine the range of real time data by clicking onto any site of interest at any time. In addition, there is an automated alert warning system. This will generate texts or emails to LPC staff members if, for example, a trigger level is exceeded. A daily report is also sent to LPC which provides a summary of all data for the previous 24 hours. VECLoud will also provide the public viewing platform, required by the website provisions of the proposed channel deepening conditions. Members of the public will be able to view a summary of real time data, (including turbidity) monthly and quarterly monitoring reports, tier 3 event reports and various other reports required in terms of the conditions.

7.18 Is the monitoring system adequate? A number of witnesses challenged aspects of the monitoring system, sometimes more than one witness raising the same point. There were four matters of concern: whether a year of baseline monitoring was sufficient, whether it was appropriate to rely on surface over benthic monitoring, that monitoring instruments cannot differentiate between natural and dredge-related turbidity and that sedimentation plates should have been used to measure sedimentation, not continuous logging altimeters. The issue of trigger values was also raised, but we shall consider this later in the context of the M-IFD system.

7.19 Before turning to the discrete issues we note two factors that influenced us. Ms Anderson gave evidence in person and impressed us in that she was considered and careful in relation to her responses. Secondly, it was evident that she had considerable hands-on experience of both designing and running monitoring systems through the course of a development project. This level of expertise was not possessed by the witnesses who questioned elements of the system, albeit they were experts in their particular fields.

7.20 The adequacy of a 1 year baseline was challenged by more than one witness. Ms Anderson responded that in its context the 1 year baseline period here was “comprehensive by any standard”. She stressed the deployment of 44 instruments at 15 stations and provided examples of the baseline periods she had used in various Australian contexts. We accept this evidence.

7.21 It is the case that turbidity has and is to be predominately monitored at a near surface level, not in the benthic region. Ms Anderson explained that instruments deployed at a near seabed level are more vulnerable, and benthic data is more variable and “noisy” (unreliable) than that obtained towards the surface. But, more importantly, monitoring results have shown that sediment is suspended through-out the water column and that stratification is not an issue. This means that monitoring near the surface is also representative of what is occurring at deeper levels. In addition, sediment sampling is to occur at depth and these TSS results will be converted to

NTU, and provide confirmation of the inter-level sedimentation relationship. Ms Anderson's concluding comment that "additional or further monitoring at the benthic would serve little purpose….." is accepted by us.

7.22 Dr Bolton-Ritchie voiced concern that the real time monitoring system could not differentiate between natural and dredge-related turbidity. This is true, but insignificant. The proposed adaptive management regime is based on measuring total turbidity, and management responses are triggered by a non-compliant total turbidity result, as will be explained later. Hence, differentiation is not required under the M-IFD approach.

7.23 Mr Geer questioned the use of a sonar logging altimeter, as opposed to a sediment plate, to measure sedimentation rates. Ms Anderson explained that the altimeter is modern, more accurate and that in her experience it has replaced the use of a sedimentation plate, including in contexts such as this. Again we prefer her evidence.

7.24 For completeness we note that the submission of the Koukourārata Development Company Ltd sought comprehensive monitoring of all major bays within a 20km radius of the disposal grounds. We accept the response that this would be to adopt a non-targeted approach. Monitoring is to occur at the entrance to Koukourārata/Port Levy, but this will not provide protection to more distant bays, not that there is any present evidence that adverse effects to more distant bays is a possibility.

Hydrodynamic Modelling of Dredging and Disposal Activities

7.25 Introduction: Dr Brett Beamsley, an oceanographer and project director at MetOcean Solutions Ltd a company based in New Plymouth and Raglan, undertook the hydrodynamic modelling investigation in support of these applications. He holds science degrees, including a doctorate, having specialised in coastal and oceanic processes; including morphology, sediment transport, wave and hydrodynamic modelling. He has 20 years professional experience in his area of expertise and has authored or co-authored over 30 peer reviewed publications.

7.26 Dr Beamsley provided six reports in support of LPC's application.
These are:

- Plumes during dredging
- Plumes during disposal (capital)
- ROMS validation
- Plumes during disposal (maintenance)
- Behaviour of sediment after capital disposal
- Behaviour of sediment after maintenance disposal

The reports detail the methodologies adopted, are comprehensive, highly technical, and include numerous supporting references and some technical notes.

7.27 No purpose would be served, nor anything gained, by our endeavouring to summarise this body of work undertaken over an extended period and including consultation with the representative technical advisory group (TAG) formed by LPC

to oversee and provide advice upon the project's development. Instead, we shall focus upon the first report, plumes during dredging of the channel, to expose the methodology adopted in relation to hydrodynamic modelling, since this will demonstrate the nature and extent of the investigation of probable effects generally. Secondly, we shall consider the more pertinent conclusions reached with reference to plumes from dredging, and from spoil disposal at both the channel deepening and maintenance disposal grounds; as well as those pertaining to dissipation of sediment from both grounds over the longer term. This will require consideration of some challenges raised to the reliability of the conclusions. Other experts questioned whether the hydrodynamic modelling provided an adequate foundation for the key conclusion that the proposed adaptive management regime would adequately safeguard the environment.

7.28 Simulation Modelling. This is the process of creating and using a computer model to predict some physical outcome in the real world; here the probable extent and movement of fine sediment plumes stirred up in the course of channel dredging and subsequent spoil disposal. This is termed hydrodynamic modelling because the aim is to predict the movement of sediment caused by the natural motion of tides and waves while it is suspended in water.

7.29 The development of a computer model to predict this outcome is complex. A wide range of variables must be considered and accommodated within the model. These include ocean influences both within and outside the harbour, the characteristics of the sediment, the dredging and spoil dumping processes, and if this is not enough some of these variables require assessment at different locations and over both immediate, and longer, timeframes.

7.30 Construction of the Plume Model: As is conventional, construction of the model to simulate plume behaviour in the Harbour began at a higher level. Global atmospheric, wave and current models, and similar regional models, were used to assess wider influences. This ensured, for example, that energy from the eddy formed when the Southland current impacts Banks Peninsula was accurately incorporated as an influence, or forcing, in the model in the outer Harbour area. Such global and regional models have a 10 year hindcast so recourse to those sources is highly reliable and standard practice.

7.31 The focus is upon identifying and incorporating the salient forcing mechanisms. Within the Harbour these were considered to be tidal and seiching[6] velocities, while in the outer harbour area where the spoil disposal grounds are located a model was needed to capture the effect of waves and currents on the morphological changes to the disposal mounds.

7.32 Sediment Size. The benthic sediment throughout the Harbour is considered to be fine. Nonetheless sampling was conducted and the sediment was divided into 4 sizes

[6] Seiching is periodic rhythmical movement in the level of a body of water at or near its natural period, which in this case is approximately 4 hours.

ranging from below 44 microns (81.8% of the sample) to 118 microns. This particle size distribution enabled different fall velocities to be assigned, reflecting the higher fall velocities of the larger particles. A literature search confirmed that the finer silt (below 44 microns) should be accorded a common fall velocity, which covered 80% of the range sizes. Modelling proceeded on this basis.

7.33 Plumes during dredging. Channel deepening and subsequent maintenance dredging is similar with respect to the generation of plumes, since the same method is to be used by LPC. The one significant difference is that maintenance dredging will be undertaken using a smaller dredge. Both will utilise a trawler suction hopper dredge (TSHD). A TSHD will generate three sources of suspended sediment, depending on the mode of operation. These are from the drag head, and the propeller wash during initial loading of the hopper; and from overflow as an additional third source, when a decision it taken to shed some of the slurry as the hopper level approaches capacity.

7.34 Modelling was based on the drag head and the prop wash each generating 2.5kg/s of suspended sediment to levels of 2m and 4m from the bottom respectively. An overflow discharge rate of 1600kg/s was modelled over intervals of 10, 20 and 30 minutes. LPC intends that the dredges used for both channel deepening and maintenance activities will be fitted with green valves in their overflow systems. The overflow is a large cylinder situated in the hopper, the height of which can be varied to receive slurry from the hopper near-surface level. This will contain more water and less sediment. Within the overflow cylinder air becomes entrained in the slurry, but a green valve prevents this occurrence. With no, or little, air in the overflow mixture, it is of higher density on its release beneath the dredge and falls as a dynamic plume to the seabed. Without a green valve the mixture containing air results in a buoyant plume which rises to the surface and is highly visible in the wake of the dredge.

7.35 Although green valves are to be used by LPC Dr Beamsley conducted the modelling as if they were not. He adopted 25% as the amount of sediment contributed to the overflow plume and this contribution was modelled as if it had been discharged at surface level, not at a depth of up to 10 metres beneath the hull. In these respects the modelling was conservative. These inputs not only overstate the amount of suspended sediment, but also assume it becomes a passive plume throughout the entire water column.

7.36 Within the Harbour the salient forcing mechanism was considered to be tidal velocities (0.3 -0.5m/s), with seiche velocities a secondary mechanism (3-4hr period at ~0.01m/s). Wind induced currents were assessed as a potential mechanism, but dismissed as having a minor to less than minor effect on plume dispersion. These tidal and seiche velocities were defined using a calibrated hydrodynamic model of the Harbour as is, and as it will be, when the channel is deepened and reclamation development at Te Awaparahi Bay is completed.

7.37 A series of particle tracking simulations were undertaken with reference to:

- 4 sediment class sizes
- different depth levels; being surface, mid-water and bottom

- each of the various plume sources for a 28 day period to capture the cycle of spring and neap tidal velocities within the Harbour,
- tidal and seiche velocities in both the Harbour configuration as is and as it will eventually be, and
- at 11 different approximately equally spaced locations along the length of the proposed extended navigation channel.

This produced a raft of plume dispersion results presented in diagrams showing contours of suspended sediment concentrations, some results being significant and some less so.

7.38 We shall refer to only some results being those that indicate the main dispersion paths, or patterns, and the extent or distance of dispersion from the plumes point of origin. These more significant results are:

- the general pattern of plume dispersion mimics the ambient hydrodynamic forcings pattern, being bi-directional in an east – west orientation adjacent to the Harbour shoreline, but with an elliptical orientation towards the Harbour entrance

- during the overflow phase significant plumes are produced of the order of 1000mg/L in all three water layers. The duration of the overflow phase controls the extent, concentration and shape (more elongated) of the resulting plumes.

- it is probable that during the initial loading phase the extent of plume dispersion is less than 500m, at all water levels, but during the overflow phase dispersion to a distance up to 1.5km at the benthic level may occur.

- representative ambient SSC levels (10, 50 and 100mg.L^{-1}) are exceeded 5-10% of the time in the mid-water level and 30-40% of the time in the bottom level, and spatial dispersion can extend up to 1 kilometre along the channel from the release site particularly in relation to the lesser SSC levels.

7.39 Channel Deepening Disposal Plumes: Disposal plumes from channel deepening, and plumes from maintenance dredging, must be considered separately given that they originate in different spoil grounds separated by about two kilometres. To recap, the likelihood is that LPC will deepen the channel in two stages separated by a period of several years using a dredge with a hopper capacity of ~10,000m^3. Spoil will be spread evenly over the 1250ha disposal area using advanced positioning navigation equipment and a grid system. Once the dredge is correctly positioned doors at the bottom of the hull are opened and the spoil is dumped in a matter of minutes.

7.40 Dr Beamsley evaluated the disposal process using 10 years of hindcast data from a calibrated and validated model. This took account of climatic variability over a suitably lengthy period. Three dredge capacities were modelled ranging from 5,000m^3 to 18,000m^3, but the capacity of 10,800m^3 in greater detail. The key source terms were referable to the percentages of sediment left in suspension during the load release from the dredge. These are shown in Dr Beamsley's figure reproduced below.

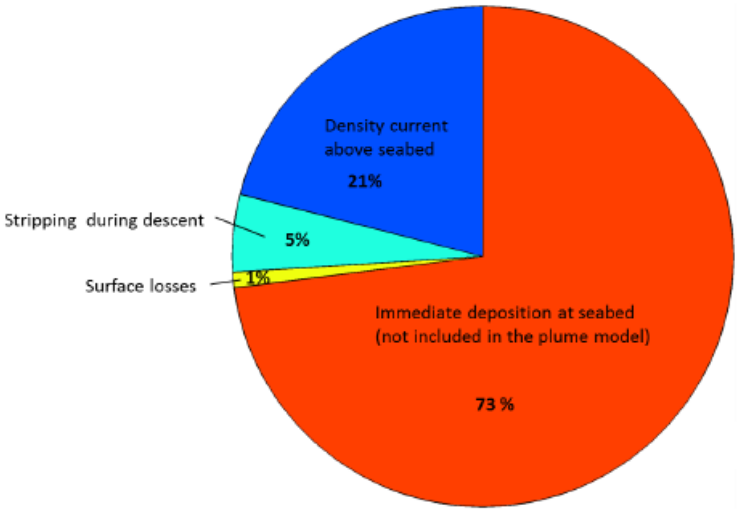
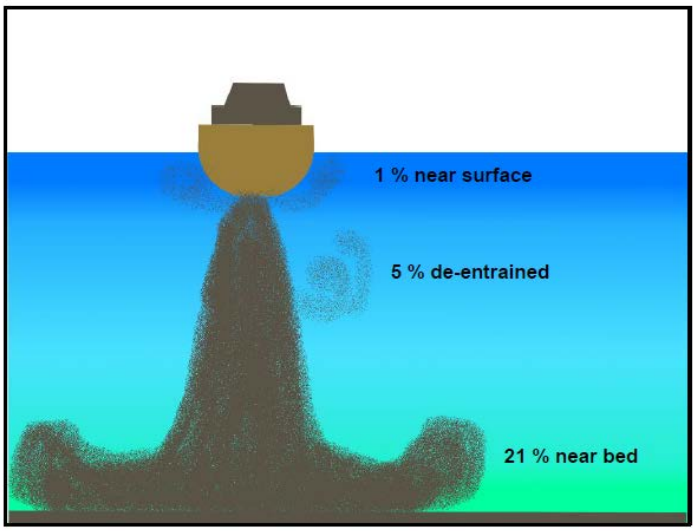


Figure 2.6 Repartition of the hopper load volume within the different source terms considered in the simulations.

Modelling proceeded on the basis that 1% remained as spillage in the near surface level, 5% was de-entrained or “stripped” during the descent of the dynamic plume and remained in the mid-water, and 21% became suspended in a 2 metre layer above the seabed. The figure below provides an impression of the plume configuration.



The remaining 73% of the sediment is assumed to have settled on the seabed and is not included in the model. The above figure is not to scale and misleading to the extend that the release depth at the LPC site will be at about the mid-point of water depth

7.41 Modelling proceeded in relation to four classes of sediment size, with particle release simulated from five locations (the centre and each corner of the disposal ground) and from various water depths. Numerous scenarios were investigated including:

- the impact of typical weather events (inducing strong nor-west and south-east currents, and nor-east wind and waves).

- the extreme individual particle dispersion footprint.
- the impact from dumping three hopper loads in succession within 2 hours and at the same position in the spoil ground.
- the duration over which ambient turbidity levels (10, 50, and 100 mg/L) were exceeded following spoil dumping in both winter and summer conditions.

Accordingly, a large volume of simulation results were generated. We shall focus on those most relevant to the evaluation of the adaptive management regime.

7.42 We note these simulation results:

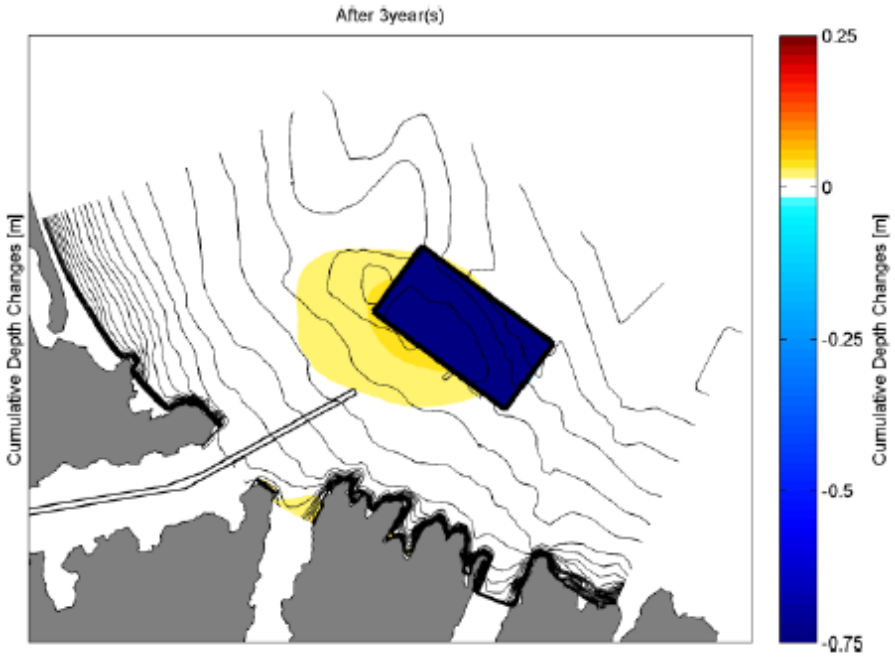
- during energetic weather events the 21% near seabed suspended sediment concentration settles within a radius of 500 metres over 30-45 minutes from dumping.
- the 10mg/L^{-1} contour of sediment plume remains within 1 kilometre in the near seabed layer, and within 500m in the mid-water layer, while at the surface plume concentrations remain below 10mg/L^{-1}.
- the 10mg/L^{-1} ambient level threshold is exceeded 10-15% of the time within a ~ 300m radius by near-bed plumes, and for 5% of the time within a ~500m radius by mid-water plumes, while exceedance of the threshold is very rare in the surface layer.
- the 1mm depositional thickness contour remains consistently within a 500m radius of the release location.
- the extreme dispersion footprint representative of a single sediment particle produces an elliptic elongated shape on a northwest-southeast axis, but does not reach the shoreline.

7.43 Post disposal sediment behaviour. The results above are plume – related and therefore illustrate dispersal levels and extents in the immediate aftermath of release. Dr Beamsley also investigated morphological changes in the longer term. That is what is likely to happen to the spoil mound at the channel deepening disposal ground and whether there will be an impact on the wave climate, or from the eventual erosion and spread of the sediment given that up to 18 million m^3 of spoil is to be dumped.

7.44 While industry standard numerical models were utilised, an absence of relevant data meant the morphological model could not be calibrated and validated. Dr Beamsley tested various parameters and was satisfied that the results obtained were consistent with anecdotal evidence. However, he saw the modelled results as only "providing guidance" in relation to morphological changes. But he also described the simulations as "conservative" because modelling proceeded on the basis that the entire volume of spoil was dumped at once, not spread over two dredging campaigns separated by a period of years as will likely be the case. This resulted in an assumed spoil depth of 1.44m throughout the spoil ground.

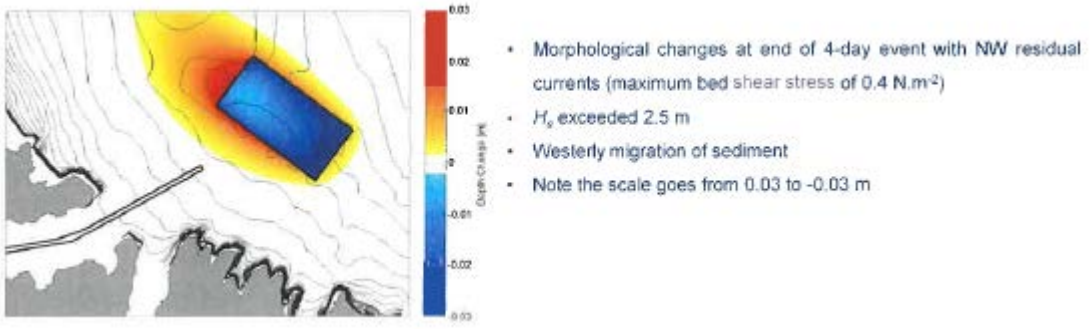
7.45 Simulations were focused on a five year time period and two real time events of high wave energy. The former investigated morphological change annually for the five year period. The key qualitative findings were:

- sediment will be transported from the entire area of the disposal grounds resulting in erosion of the dumped sediment volume after 5 years.
- the mobile sediment will be progressively spread over an increasingly large area, with a small volume reaching the nearshore zone.
- by the end of the 5 year period the spread sediment is predicted to be less than minor in terms of thickness.



This figure indicates the sediment depth after 3 years, when the spread pattern was closest to the shoreline and some sediment was at the entrance to Koukourārata/Port Levy.

7.46 The two high energy events simulated 4 day north-westerly and south-easterly storms. Dispersion from the spoil ground is depicted in this figure.



The south-easterly event produced a similar result, but with an obvious eastwards migration of sediment. The directional trend of these two simulations suggests that wave action is the primary driver of morphological changes, not the forcing effects of residual and tidal currents.

7.47 Maintenance Disposal Plumes. Maintenance spoil is to be dumped in a smaller disposal ground approximately 2.5 km off Godley Head. The same methodology as used for channel deepening disposal plumes was followed, except that some source terms needed to be changed on account of the smaller dredge to be used for maintenance dredging. The hopper volume was reduced to 1840m^3 and the draught of the vessel, which defines the depth level at which spoil is discharged, was reduced to 4 metres. Retention of the same suspended sediment percentages (1%, 5% and 21% - see 7.16) was another conservative approach taken by Dr Beamsley, in that the water depth at the maintenance ground is shallower by a few metres.

7.48 As with the channel deepening disposal ground the results obtained are comprehensive. For present purposes the most important results are:

- the 10mg/L^{-1} contour generally stays within 1 km of the release site for all three water levels, with most of the sediment within a 300m radius of the release site.
- the 1mm depositional contour is consistently within a 500m radius of the release site.
- the plumes of highest concentration and extent are found in the near-bed level, and the concentration will typically drop below 100-200mg/L^{-1} within 1km of the release site.
- an extreme deposition footprint representative of a single particle released from the south western corner of the maintenance grounds extended to Godley Head and southeast of Port Levy/Koukourārata, as depicted below.

The yellow line represents the 99th percentile of the ambient sediment level, while the black dotted lines are 500 and 1000m circles from the release point. Dr Beamsley's report notes with reference to the extreme contour line that "in reality the fine sediment…(is) unlikely to settle at or near the shoreline due to the energetic nature of the coastal zone."

7.49 Post Disposal Maintenance Sediment Behaviour. The proposal is to dump spoil in the 256ha ground located over 2km off Godley Head, but also use the existing consent to dump spoil at Godley Head when weather conditions inhibit the smaller maintenance dredge from venturing offshore. Maintenance spoil is projected to be of the order of 0.9million $m^{3,}$ per annum, which if spread evenly in the offshore ground would produce a sediment thickness of 0.35m

7.50 A set of bathymetry scenarios were modelled to investigate the effects from the deepened channel alone, the effects from the new channel and each spoil ground in isolation, and the effects from the new channel and both spoil grounds in combination. A further scenario explored effects from an equal split of the annual maintenance spoil volume between the offshore and the Godley Head grounds. The morphological model could not be calibrated and validated due to a lack of field data; hence the results are qualitative in nature. The scenarios simulated provided information on patterns of both increased and reduced wave heights arising from seabed changes. Those results are most relevant to the potential for impacts upon adjacent surfing beaches and will be considered in that context.

7.51 The morphological results are most relevant to understanding the likely extent to which the extended and deepened channel will suffer recirculation infill from each of the offshore spoil grounds, and from the Godley Head ground. These results indicate:

- sediment from the larger spoil ground may reach the outer end of the new channel, but not in significant amounts.
- due to the proximity of the offshore maintenance ground to the extended channel there is greater potential for recirculation into the channel.
- Importantly, if the annual maintenance spoil volume is evenly split between the offshore and Godley Head grounds the infill volumes in the channel will increase 2 to 3 times in terms of volume.

7.52 The reliability of Dr Beamsley's modelling. The reliability of the modelling results is of considerable importance. The essence of the adaptive management regime is that sentinel monitoring sites will detect turbidity levels during dredging, being a mix of natural and dredge-related turbidy, and provide a warning when a management trigger level is reached. Such trigger levels are to be set at the 90, 95 and 99 percentiles of the typical ambient turbidity level at that site, plus a component for dredging turbidy as predicted by the hydrodynamic modelling. If the trigger level is set too low dredging activity will be interrupted unnecessarily. Conversely, if the level is too high dredging will continue while turbidity levels pose a threat to the environment.

7.53 Three witnesses provided assessments upon the quality of the hydrodynamic modelling. Mr Connon Andrews, an experienced metocean and coastal engineer with Beca Ltd, prepared a report for the Regional Council. Dated in late February, the report included this conclusion: "Overall, the numerical modelling assessment has resolved the primary processes and delineated the relative changes to physical coastal processes based on dredging process assumptions. The results presented in the assessment are for a range of scenarios reflecting the likely range expected from

the proposed dredging operation." Mr Andrews also noted that further information was awaited from Dr Beamsley concerning certain aspects of his work, but expressed the view that the "underlying findings would not significantly change."

7.54 Mr John Oldman, an experienced coastal scientist with the Danish Hydraulic Institute (DHI), advised Ngāi Tahu in relation to the modelling study. His subsequent evidence filed in support of Ngāi Tahu's submission raised concerns about various aspects of Dr Beamsley's work. Indeed, with reference to whether the modelling represented best practice to inform the preparation of an environmental monitoring and management plan, Mr Oldman said: " The modelling presented in the application does not go beyond the typical modelling that is carried out in the early phase of an EIA - i.e. the initial assessment of broad scale effects. In the application, only limited calibration of the sediment transport models had been carried out, there appears to be no plan to further calibrate models using monitoring data and the feedback between using calibrated models to inform the EMMP process seems to be totally lacking. The parameters presented in the evidence used to calibrate the model are not used to rerun the model so the results in the application are based on an anecdotal validation." We could not imagine how these two starkly conflicting opinions could be reconciled, an issue to which we will return in a moment.

7.55 Dr Wayne Stevenson, a senior lecturer in environmental management and physical geography at the University of Otago, also provided evidence for Ngāi Tahu. He raised particular concern that the LPC application did not include a whole of system sediment budget for the Harbour. He also supported Mr Oldman's concern that the potential for wind induced waves within the Harbour to induce sediment resuspension and increase near surface plume dispersion had not been modelled, nor in his opinion had the parameters that influence passive plume dispersion from overflow slurry been adequately evaluated and modelled. Our conclusions concerning the suggested modelling deficiencies will become evident shortly, while the sediment budget issue is best considered in the coastal processes section of the decision.

7.56 Both Dr Beamsley and Mr Oldman provided written evidence for, and were questioned, at the hearing before us. Dr Beamsley's written evidence included a detailed rebuttal of the various criticisms levelled at his modelling work. Three days later Mr Oldman sought to respond to the rebuttal, but found difficulty in doing so on account of the complexity of the subject matter and time constraints. At the conclusion of his evidence we offered him the opportunity to provide a written response, which he did a few days later. We have found the time we had to assess both men in person at the hearing helpful.

7.57 Prior to the hearing there had been a hui in January 2017, followed by two meetings in an endeavour to resolve or narrow the areas of dispute. Dr Beamsley, Mr Oldman and others attended these. Events at the hearing in early May prompted the convening of a caucus of the three key witnesses in relation to hydrodynamic modelling, namely Dr Beamsley, Mr Oldman and Mr Andrews. This was held at Raglan on 10 May. On the last day of the hearing, Friday 12 May, a signed joint report from the experts was available and was the subject of explanation, and submission. It proved to be of considerable assistance.

7.58 The experts report contained answers to 25 questions, most of which were multi-faceted. Two questions were not answered, being outside the expertise of the experts. On our assessment most questions, thirteen in total, resulted in answers indicating general agreement. Five questions concerned alternative, or additional, elements that could have been modelled, but where it was acknowledged that either the approach taken by Dr Beamsley was conservative (i.e. erred towards higher sediment concentration or plume extent), or alternatively that the excluded element would have made only a minor or less than minor difference to the modelled results. Five questions were the subject of disagreement. Significantly, all five concerned Dr Beamsley's decision to not model wind, waves and resuspension as combined forcing mechanisms in relation to Harbour modelling.

7.59 This area of disagreement requires evaluation. Dr Beamsley considered whether local wind induced waves could influence plume behaviour or cause sediments resuspension from the seabed in the Harbour area. He concluded, after discussions with other experts, that the salient processes were tidal and seiche velocities and that wind induced wave currents were of minor or less than minor effect. (see 7.36) Modelling was undertaken on this basis. Mr Oldman strongly disagreed with this approach and said so at the hearing. He also considered that the movement of the dredge should be included as a further additional source in the Harbour related modelling. Had this been done he believes altered plume behaviour would have resulted and sought to support this by reference to what he acknowledged were uncalibrated and unvalidated modelling results.

7.60 Mr Andrews agreed that modelling the effects of wind, waves and resuspension "will affect the spatial extent of the plume", but he doubted that resuspension would be "significant except for around Cashin Quay." He added that "for specific events the plume will extend beyond the averaged (modelled) plume footprints for short periods of time". Dr Beamsley responded that "including secondary minor effects associated with wind on the dispersion of plumes will result in only minor effects" and "the effect…on the plume behaviour will be largest in the near surface region, and decrease exponentially with depth". As to resuspension he considered it "only likely around Cashin Quay"[7].

7.61 Another question included whether these combined effects would "cause additional cross Harbour plume movement" and whether it was "likely" this would "result in plumes reaching the shoreline." There was agreement that cross Harbour movement would occur, but that the "averaged predicted plumes were not expected to reach the shoreline, except adjacent to the port."[8]

7.62 Finally, a further question was whether it was "best practice" in relation to this dredging project to model "wind, waves and resuspension, and a moving dredge in combination…." Dr Beamsly responded that there were two schools of thought; one a 'belts and braces' approach where everything is modelled, and the second an

[7] Joint Expert Caucus Report, 10 May 2017, Paragraph 5.9

[8] Joint Expert Caucus Report, 10 May 2017, Paragraph 5.10

"issue-focused" view where salient processes are identified and only these modelled. He took the second option, whereas Mr Oldman responded simply "yes" that a consideration of all four elements in combination was best practice. Mr Andrews said "I would consider including the effects of wind, waves and resuspension for completeness."[9]

7.63 We found the sequence of answers to the above questions informative. Clearly there is art to the application of the science of modelling. The modeller is required to make value judgements concerning which, and the number of, elements to be modelled. In reviewing or critiquing his work there is scope to find fault and contend that elements have been wrongly excluded from, or incorrect values included, in the model. It is important, therefore, to evaluate contentions carefully, including by examining their import. What difference, if any, would it have made if a different element was included? And, has the chosen course produced a result that understates the risk, here to the environment; or is any variation in the predicted outcome truly insignificant?

7.64 We find that in this instance assessing the critical contentions by reference to their import has resulted in a number of them falling away altogether, in others becoming of no moment because they are of no, or insignificant effect, and other contentions have fallen into the void of legitimate difference of expert opinion. Another result to come out of the evidence, hearing and caucusing processes is that it has emphasised areas where Dr Beamsley elected to take a conservative approach and include in the model elements that increase the intensity and extent of turbidity, not the reverse.

7.65 These include, for example, his decisions to exclude the impact of a green valve in relation to overflow slurry, adopting 25% as the level of sediment de-entrained during the overflow mode, assuming that overflow was discharged at the surface rather than beneath the dredge hull, ignoring that channel deepening spoil would be dumped in two separated stages and, in consequence, assuming that the spoil height in the larger disposal area would reach 0.44m above the seabed.

7.66 We find that Mr Andrews favourable assessment[10] concerning the reliability of the modelling is to be preferred to Mr Oldman's highly critical view. We consider that Dr Beamsley took a considered and measured approach to development of the hydrodynamic models. An aphorism coined in relation to model development generally is that "all models are wrong, but some are useful."[11] We are well satisfied that the models here are useful.

7.67 <u>The M-IFD Approach</u>

LPC proposes to monitor turbidity levels at sentinel monitoring sites strategically located near to the channel and spoil disposal areas. The monitoring system is one

[9] Joint Expert Caucus Report, 10 May 2017, Paragraph 5.14

[10] See 7.53

[11] Attributed to George E P Fox, a British statistician

that has been used successfully elsewhere. It provides data from which the three parameters used to characterise turbidity conditions, namely “intensity” “frequency” and “duration” can be extrapolated. This can be done at the monitoring location most adjacent to where dredging or disposal activity is occurring. Known originally as the IFD system, it has now been modified in an endeavour to improve its efficacy; hence the M-IFD approach that LPC proposes to use to manage protection of the marine environment. In essence, the M-IFD model incorporates a trigger value system of three levels. Levels one and two require management actions to decrease turbidity levels that are on the rise from dredge-related activity. A level three exceedance requires a cessation of dredging activity until such time as turbidity returns to a compliant level.

7.68 An IFD approach was first proposed by a group with the Environmental Protection Agency in the United States in 2002. Subsequently, the approach found favour in Australia where it has been well used in a number of large dredging and similar projects. The Australian/New Zealand Fresh and Marine Water Quality Guidelines, 2000, endorsed the concept of trigger values (TVs) as “an early warning mechanism to alert managers of a potential problem”, an approach that was therefore, compatible with the American IFD –based management system.

7.69 The IFD system is underpinned by the following logic:

- physical – chemical stressors are naturally present in a marine environment.
- the continued existence of flora and fauna in that environment is evidence of their resilience to naturally occurring stressors, including their episodic extremes.
- therefore, provided an anthropogenic stressor (here turbidity) does not elevate the total stressor level and duration above that which may naturally occur, the environment will be protected.

Application of this logic requires an understanding of the natural stressor patterns gained through water quality monitoring, systems to monitor particularly the predominant stressor during dredge-related activity, and the establishment of TVs that require management action or activity cessation before harm to the environment eventuates.

7.70 Water Quality Monitoring: The monitoring programme designed by Ms Leone Anderson has already been described at 7.2 to 7.17. Professor David Fox the architect of the IFD modification, is a director of Environmetrics Australia, and a statistician with degrees in mathematics and statistics to a doctorate level. He has a teaching and research background, and since 2009 has provided statistical services to industry. This resulted in his working collaboratively with Ms Anderson in relation to some dredging-related projects.

7.71 Professor Fox is of the opinion that the use of TVs for managing large scale dredging projects is now a peer-reviewed and recognised strategy in both Australia and New Zealand, and elsewhere throughout the world. For completeness, we note that he agrees with Ms Anderson that a year of background data is sufficient, and has been the norm for comparable projects in which he has been involved.

7.72 Professor Fox also provided evidence confirming the need for quality assurance processing of turbidity data, something he termed a “critical activity”. There are three aspects:

- the identification of false or aberrant readings, followed by their removal where justified.
- reduction of the influence of high-frequency oscillations which give rise to spurious readings, recognisable as such, that are removed through statistical filtering
- reconstruction of data to fill gaps due to instrument failure through examination of the before and after data pattern.

Such quality assurance steps are standard industry practice and therefore are well understood and accommodated using established methods.

7.73 In relation to the LPC dredging project there is also a need to harmonise turbidity data. Monitoring of turbidity occurs predominately at the sub-surface and is measured in NTU, but monthly water samples are taken at depth and measured in TSS. In addition such data is derived at multiple locations both within the Harbour and offshore. Hydrodynamic modelling is conducted in TSS, while the M-IFD system uses trigger levels measured in NTU. Accordingly, a TSS to NTU statistically valid conversion relationship must be determined, and whether a single relationship can be used or multiple site-specific relationships will be required, is unclear. The answer will be known when the baseline data collection programme is completed and a statistical analysis determines the answer.

7.74 The M-IFD system: The system proposed by the American group relied upon three components; intensity, frequency and duration, assessed with reference to some relevant environmental indicator to warn when management intervention should occur. Based on his experience of the IFD system in Australian contexts Prof. Fox came to consider that reliance upon the three parameters independent of each other was in error. His viewpoint, supported by mathematical analysis, was that the parameters were interrelated such that the selection of one value could determine the magnitude of the others. Intensity remained the key parameter, but he concluded that frequency and duration should be collapsed into one parameter being “allowable duration”. This is the maximum number of hours in a rolling (in this case) 30 day period over which the intensity level prescribed at a monitoring location may be exceeded without a management action being required. The calculation of the allowable duration figure is best explained in the context of the turbidity triggers proposed for LPC’s project.

7.75 Turbidity Trigger Levels. Turbidity triggers are required for each telemetered turbidity site. Each site requires three triggers, one for each of the three tiers of management response. Intensity is the first, and key, component. The intensity level for each tier is:

Tier 1	80% of total turbidity
Tier 2	95% “ “ “
Tier 3	99% “ “ “

Total turbidity at each telemetered turbidity monitoring site is established for each percentile by:

- calculating from a least one year of time series baseline monitoring data the percentile turbidity value in NTU, and adding
- a component for the percentile turbidity value from dredging as predicted by TSS modelling over the same time period but after conversion of TSS to NTU.

7.76

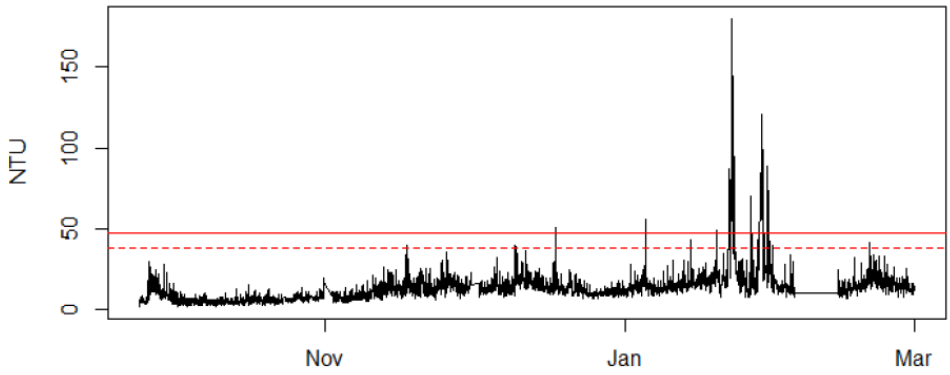


Figure 39. Illustrative example based on baseline data from UH1 from 24/9/2016 to 28/2/2017. Raw turbidity data shown in black; red dashed line is nominal Tier 3 trigger value; red solid line is adjusted Tier 3 trigger value.

Figure 39 above depicts baseline turbidity data in black, for only a three month period. It also shows the 99th percentile of natural turbidity (red dotted line); and the same percentile but with an allowance for dredge-related turbidity added (solid red line). As can be seen extremes of natural turbidity can far exceed the 99th percentile, or tier 3 trigger value, represented by the solid red line.

7.77 This total turbidity amount for a given percentile indicates what fraction of intensity exceedance can be expected and also identifies the allowable exceedance time before management action is required. At the 80th percentile 20% of exceedance can be anticipated, and so on, in relation to the 95 and 99 percentiles. Under the M-IFD approach the modified allowable duration is likewise determined by the exceedance percentage. Over a 30 day rolling period there are a total on 720 hours. So the 80 percentile turbidity trigger has an allowable duration of exceedance of 144 hours (20% of 720) assessed over the previous 30 days.

7.78 Taking a hypothetical total turbidity of say 44.7 NTU, the trigger levels for a monitoring site would be calibrated as follows:

	Percentile	**Intensity NTU**	**Allowable Duration**
Tier 1	80th	35.76	144 hrs per 30 day rolling period
Tier 2	95th	42.46	36 hrs " " " " "
Tier 3	99th	44.25	7.2 hrs " " " " "

A tier 1 event would occur once an intensity of 35.76 was reached and the 144hr allowable duration was also spent. A defined management programme would need to be activated, and if the event escalated to a tier 3 exceedance a cessation of dredging would become the required response.

7.79 Challenges to the M-IFD Methodology: The submissions raised numerous questions and concerns about the M-IFD methodology, in particular concerning how the trigger levels would be set and whether they would prove to be effective. This was understandable since calculation of them is still a work in progress that will not be completed until the baseline monitoring programme has run its course. Also, the proposed conditions have gone through a number of iterations, much of the change being to the "Turbidity Triggers" section. In response to a Minute issued by the panel after the final hearing day an appendix 2 has been introduced, entitled "Statistical Methodology Outline – Development of Intensity Component of Turbidity Triggers." This supplies answers to various of the concerns raised during the hearing.

7.80 Dr Daniel Pritchard is a scientist employed by Te Rūnanga o Ngāi Tahu, with special interests in seaweed ecology and hydrodynamic modelling. He is a member of the TAG and has played an active role at its meetings. His evidence included a number of questions directed to the turbidity trigger methodology. Having sat through the hearing Dr Pritchard provided summary and response evidence which confirmed that some of his concerns had been answered by Dr Fox at the hearing. He acknowledged that "the statistical methods proposed for this project are appropriate and can generate appropriate trigger values". However, some residual concerns remained. These related to aspects of the hydrodynamic sediment simulations used to calculate the contribution of predicted dredging turbidity added to baseline turbidity in establishing the intensity trigger levels. Without these details Dr Pritchard considered it was not possible to judge whether the trigger values would provide the intended level of protection to the environment. In addition he sought a "methods document" to provide such details.

7.81 Before evaluating Dr Pritchard's remaining concerns we shall refer to the Regional Council's witness in relation to statistical considerations, Mr Dougal Greer, a scientist with particular experience in relation to sediment transportation and time series data analysis. He audited the reports from Ms Anderson and Dr Fox filed in support of the application. Mr Greer's evidence included an assessment that "the proposed methodology for calculating TV's is robust and appropriate for use in this project". That said, he went on to identify several matters that required clarification, including a need for consent conditions that imposed specific obligations relating to the turbidity triggers.

7.82 We consider that the matters raised by Dr Pritchard and Mr Greer were, generally speaking, legitimate issues of concern. In large measure we are satisfied that these concerns have now been met. New definitions, revised consent conditions and the emergence of appendix 2 to the proposed channel deepening conditions have answered issues that remained when the above witnesses gave evidence. Even a final memorandum from counsel for LPC dated 2 June advanced matters with regard to the models used to predict in-harbour and offshore dredge-related turbidity levels,

the extent and nature of the time series data and the requirement for a temporal match between modelled and monitored turbidity used in fixing the turbidity triggers.

7.83 While the manner in which additional information and drafting changes have emerged has been less than ideal, this is probably understandable. Intensity values can only be set after completion of the baseline period, a complication of a kind not uncommon in an adaptive management context. As recognised by the IUCN in its comments quoted with approval in the King Salmon decision (see 4.10) an adaptive management approach is:

> "particularly useful in the implementation of the Precautionary Principle as it does not necessarily require having a high level of certainty about the impact of management measures before taking action, but involves taking such measures in the face of uncertainty, as part of a rigorously planned and controlled trial, with careful monitoring and periodic review to provide feedback, allowing amendment of decisions in the light of such feedback and new information."

7.84 Here the proposed conditions provide for ongoing monitoring, periodic review and contemplate amendments in light of experience. And, proposed condition 9.4 provides:

> "The consent holder shall provide to the Consent Authority, at least two months prior to commencement of a Dredging Stage, a written report prepared by a suitably qualified and experienced expert which demonstrates that the turbidity triggers have been established in accordance with conditions 9.2 and 9.3."

Overall, we are satisfied that the M-IFD approach provides adequate assurance in this case. Referring to the threshold question posed in the King Salmon case (see 4.11) we consider that there is an evidential foundation to regard the M-IFD system as adequate to reduce uncertainty, and manage environmental risk. But it remains to consider the ultimate question posed in King Salmon. We shall do this after our evaluation of all the effects.

8.0 Coastal Processes

8.1 The subject of coastal processes was addressed for LPC by Dr Thomas Shand. Dr Shand has a phD in coastal engineering from the University of New South Wales. He has 12 years professional experience in coastal engineering with Tonkin and Taylor Ltd and the UNSW Water Research Laboratory in Australia. He is a senior coastal engineer withTonkin and Taylor.

8.2 Dr Shand familiarised himself with other relevant reports prepared for this application, particularly the MetOcean reports on the modelling of plumes and disposal mounds. His report describes the coastal process in Pegasus Bay and within Lyttelton Harbour/Whakaraupō in some detail. The principal drivers of coastal processes are waves, currents and sediment supply. Pegasus Bay has historically been a deposition area as has Lyttelton Harbour/Whakaraupō. Dr Shand noted that any changes in

shoreline morphology must be driven by changes in waves, currents or sediment supply.

8.3 CDP potential effects: He then considered the CDP and its potential effects on these primary drivers and concluded that;

a) In regard to waves that the CDP would alter wave effects on the shoreline outside the harbour to only a minor to less than minor degree. In reaching this conclusion he relied on the MetOcean modelling. Within the harbour, he noted that changes will be more permanent as they are caused by the permanent changes to bathymetry brought about by dredging. He noted that reductions in wave height of up to 33% within the upper harbour section of the navigation channel and an increase of up to12% on either side of the channel, may be expected; adding that because the harbour is very sheltered these changes will be small in magnitude.

b) In regard to tidal flows he noted that changes were small (5-10% of peak flow), were confined to the channel and were therefore unlikely to significantly affect shoreline processes.

c) In regard to sediment transport Dr Shand noted that modelling results indicate that plumes generated from dredging activities are mainly confined to the channel and do not appear to reach the shoreline. Similarly, the plumes from the main offshore disposal ground tend to be confined to an area between 500 -1000 m from the disposal site, and hence, were extremely unlikely to reach the shoreline in any significant concentration. He acknowledged that some particles deposited at the maintenance disposal site may reach the entrance to Lyttelton Harbour/Whakaraupō and Port Levy. Dr Shand also pointed out that once settled these particles became part of the background sediment (the fluid mud layer), would be moved around Pegasus Bay and become indistinguishable from the background sediment.

d) Dr Shand considered that the sediment sinks within the harbour (channel plus berth pockets) will be affected by the deepening project. He expects that with the deepened channel, and the use of the offshore maintenance disposal ground there will be a net loss of sediment from the system. Over time he expects that the filling of maintenance dredging sites will accumulate material sourced from the bank areas adjacent to those sites. .

8.4 With regard to the mechanisms discussed above, Dr Shand listed the expected effects of the capital dredging works under headings as follows:

- **Morphology of the open coast**. No changes are likely because as noted above the factors that shape the open coastline remain unchanged and in the unlikely event that dredged sediment reached the inshore coastal zone, energy at the shoreline will not allow such sediment to settle and reside there.
- **The location of open coast beaches** are unlikely to be affected as the sediment regime required to form a beach will remain unchanged and the sediment from dredging is incompatible with such a regime.

- **The composition of open coast beaches** are unlikely to change; again because the velocities and energy in these regions is too great for the fine dredged sediments to allow accretion.
- **The composition of the harbour shoreline** within Lyttelton Harbour and Port Levy will remain unchanged. The reason is two-fold. Firstly, modelling shows that plumes are unlikely to reach the shorelines. Dr Shand again noted that the relatively high energy shoreline prevents accumulation in these zones, and that the dominant sediment pathway for fine sediments is from shallow to deeper water.

8.5 Maintenance dredging potential effects: Dr Shand then considered in the same general way the effect of maintenance dredging. His conclusions under each of the above headings remained unchanged, however, he noted the removal of sediment by maintenance dredging from the channel inside the harbour to outside the heads will result in slow erosion of the seabed in the locality of the dredging sites. While it is not clear how the spatial distribution of this loss will occur, it is expected to be widespread and because of the very flat slopes of the seabed in the harbour this effect could spread further afield.

8.6 Assessment concerns: Dr Shand's evidence responded to points made by submitters Nancy Vance, Te Hapū o Ngāti Wheke et al and Koukourārata Development Company Ltd. We deal with each of these in the same order. Nancy Vance indicated concern regarding chemical substances that may be in the dredged substance and the potential causes and pathways of sediment movement within that harbour. Dr Shand noted that current literature, and modelling, had identified sources of sediment and the sediment pathways around the harbour entrance.

8.7 Te Hapū o Ngāti Wheke et al (which includes Te Rūnanga o Koukourārata, Ngāi Tahu Seafood and Te Rūnanga o Ngāi Tahu) employed Dr Wayne Stephenson to review the application in relation to coastal processes. Dr Stephenson expressed concern that an overall sediment budget for the harbour had not been adequately considered. We note that Dr Shand did consider this matter, at least in part, when he commented on the removal of maintenance dredging quantities in paragraphs 20, 35 and 43 of his evidence. Here, he discussed the effect of a net loss of sediment from the lower harbour system noting that the expected effect will be a slow lowering of the seabed in the region of the maintenance dredging sites. Monitoring to check this effect was suggested.

8.8 In response to a question from the panel, Dr Stephenson acknowledged this potential effect but did not elaborate on any other effect of significance that may occur through the omission of a comprehensive sediment budget for the harbour. We therefore conclude that despite the application not containing a sediment budget, this indicated no omission of environmental consequence.

8.9 Two other concerns were expressed by Te Hapū o Ngāti Wheke et al concerning baseline data collection and the cumulative long term effects of the excursion of disposed sediment towards the shoreline and entrance to Port Levy. Dr Shand responded that a significant program of data collection is under way and will continue

well into the future. This combined with existing data will provide an adequate baseline record with which to compare physical shoreline changes. The Panel is not left with concerns in this regard.

8.10 On the matter of long term cumulative effects of the products from the disposal mounds, Dr Shand noted that following the eventual erosion of the mounds to existing seabed level, the dredged material will become part of the existing fluid mud layer and thus behave as that layer does now. He expects no adverse effects associated with these processes to occur.

8.11 The Koukourārata Development Company Limited expressed concern regarding

a) sedimentation of the Harbour and sediment build up at the coastline; and

b) the performance of dumped spoil in the long term, including the effects of climate change.

We consider that both of these matters (except climate change) have been dealt with in the paragraphs above. With respect to climate change, Dr Shand noted that the changes to coastal processes are unlikely to exacerbate any physical effects of the spoil mound on the shoreline. Notwithstanding this conclusion, monitoring of the shoreline is to be undertaken as set out in the conditions. (See plan RC172455E and clause 8.9 of the channel deepening conditions).

8.12 The authors of the S42A report raised a number of matters regarding coastal processes to which Dr Shand provided responses. In particular, the report writers suggest there was a need to take a conservative approach to coastal processes and that a monitoring site should be added within Diamond Harbour. In addition, monitoring of sediment deposition on the subtidal rock reef was sought. Dr Shand noted monitoring of seabed profiles, including a transect into Diamond Harbour, is already underway and will continue annually for 5 years following the dredging programme. Dr Shand did not accept that monitoring the settlement of fine sediments on the subtidal rocky reef was likely to be effective, because the high energy nature of these nearshore environments does not permit settlement and modelling has also demonstrated the relatively limited excursion of sediment plumes.

8.13 Overall, the Panel is satisfied that potential adverse effects of the CDP on coastal processes have been well considered and that no residual adverse effects, - short or long term - are likely to accrue. We are also satisfied that the proposed monitoring is well structured and provides assurance that any unanticipated effects will be detected.

9.0 Benthic Ecology

9.1 Introduction: The assessment of effects upon benthic ecology was provided by Mr Ross Sneddon, an experienced environmental scientist at the Cawthron Institute in Nelson. His particular area of expertise is the ecological effects of stressors associated with discharges to the coastal marine area. His report in support of the

application entitled “Assessment of Impacts to Benthic Ecology and Marine Ecological Resources from the Proposed Lyttelton Harbour Channel Deepening Project” is comprehensive and thorough to say the least. Field surveys conducted in 2007- 08 and 2016 provided a basis for his report. His response evidence included this:

“Survey work I have been involved with in relation to the sites of potential concern spans a 10 year period and has involved SCUBA diving, benthic sampling and transect methods, as well as the collection of hydrographic and hydrodynamic data via side-scan sonar and deployed instruments.”

He is a member of the technical advisory group (TAG).

9.2 The affected area: Mr Sneddon’s evidence noted that the proposed extensions to the channel will result in a newly dredged area of the about 125ha; which when added to the area of the existing channel and swing basin area, will produce total dredged areas of about 280ha. Eighty percent of the increase will result from the extension outside the Heads, meaning that the dredged increase within the Harbour is about 30ha and represents 0.7% of the total Harbour area. The increase outside the Heads represents around 5% of the area of the Harbour entrance and approaches. In addition, LPC’s intention to establish new offshore spoil grounds involves areas of 1250 and 256ha, a total of 1506ha. The seabed areas of inshore Pegasus Bay and Lyttelton Harbour are relatively flat and are dominated by fine soft sediments, although the Harbour sediments are more variable in texture.

9.3 Effects Assessment: Mr Sneddon assessed the likely effects on benthic ecology by reference to:

- the direct impact of dredging on the same seabed,
- the dispersal of plumes from dredging as predicted through hydrodynamic modelling, and
- the deposition of spoil at the dumping grounds, and its dispersal both immediate and longer term.

He considered that dredging on account of the “nature and scale would result in the complete loss, albeit temporary, of all benthic communities…within the areas directly affected by (the) activity”. The same result was assumed in relation to the spoil grounds; with a spreading zone margin of 300-1500m around each ground that “will potentially…be affected by direct deposition.”

9.4 In relation to the wider marine environment he used the results from Dr Beamsley’s modelling to assess whether there was potential for effects on benthic communities. Plumes from both dredging and spoil deposition required assessment. Mr Sneddon concluded that suspended sediment plumes would have minimal effect beyond a 500m contour around the spoil grounds; while dredging plumes would be largely contained within; or near to, the channel itself. The impact of this sediment dispersion must be assessed against the background that the affected seabed areas are a naturally turbid environment in any event, a phenomenon with which Mr Sneddon was familiar as a result of his survey work including diving. Communities could

potentially be affected, but this will depend on whether the man-made turbidity increased total turbidity to a new level sufficient to stress seabed biota.

9.5 Communities in the sediment have been sampled by Mr Sneddon both within the Harbour and offshore. This revealed the presence of macroinvertebrates, small animals ranging down to a size of 0.5mm, but the communities were sparse and also low in terms of the spread of species. The area of the existing channel and the Godley Head maintenance spoil ground were found to support even less diverse and abundant sediment communities, with marine worms being the dominant (70% of the sample) species.

9.6 Mr Sneddon's key conclusions were:

- The seabed habitat at the two proposed offshore spoil grounds is a dynamic sedimentary environment and is also limited in extent when viewed in the context of the large Pegasus Bay area.
- The benthic communities are dominated by small invertebrates with short life-cycles; they are adapted to a high turbidity environment and will rapidly recolonise seabed sites disturbed by dredging or spoil deposition.
- Spoil deposition in the larger offshore ground will be in two stages, separated by a period of years and will be incremental over up to 14 months during each stage; allowing recolonisation to occur throughout the project timeframe.
- The composition of both spoil and sediment suspended in plumes will have a high degree of similarity to the natural sediment in the affecting areas.
- Any affects on benthic communities beyond the 500m contour around the spoil grounds, and a small distance away from the channel area, will be minimal.

Given these mitigating factors Mr Sneddon concluded that the recovery of benthic community habitats following spoil and sediment deposition will be "relatively rapid". Since the channel will be subject to periodic and ongoing maintenance dredging habitat disturbance will continue in the channel area.

9.7 Evaluation: Mr Sneddon gave evidence before us and was impressive on account of his measured and careful approach. His evidence in relation to benthic ecology was questioned to a limited degree by Dr Lesley Bolton-Ritchie, a marine ecologist with the Regional Council who provided evidence in support of the Section 42A report. She expressed concern that sediments dredged from deeper in the channel profile may prove to be dissimilar in nature to the native sediments in the spoil ground, and cause a lasting alteration of the habitat. Secondly, Dr Bolton-Ritchie considered that ongoing monitoring of the soft sediment epifauna communities should not have been excluded from the monitoring programme.

9.8 Mr Sneddon accepted that there had been no assessment of sediment down to the full depth of the dredge cut, but doubted that this posed a problem. The sediment history of the harbour is well understood and suggests that the physical makeup of deeper sediment is unlikely to vary from that of higher sediment. Should there be some chip material this could possibly change the spoil ground habitat over an intermediate time-frame. But, he doubted the possibility of long term change and,

drawing on his experience of a spoil ground change in Port Nelson, noted that the dumping of less friable sediment in a spoil ground can result in an increase in biodiversity as opposed to an adverse effect. In relation to the exclusion of epifauna monitoring he explained that this was considered, but rejected in light of the results from 29 research dredge tows undertaken in benthic areas. These revealed such sparseness of organisms that it was concluded, ongoing future monitoring was unlikely to provide meaningful results in relation to changes attributable to the project.

9.9 These two concerns were properly raised, but in our view have been met by virtue of Mr Sneddon's reply evidence. We consider he is advantaged in making the above assessments on account of his hands-on involvement in survey work and membership of the TAG. More generally we are satisfied that the effects assessment and conclusions reached, with regard to benthic ecology are soundly based.

10.0 Reef and Shoreline Ecology

10.1 Mr Sneddon's report referred to in the previous section covered reef and shoreline ecology, as well. He characterised the central and outer shoreline as comprising relatively steep rock profiles, in keeping with the description of the Harbour as a rock-walled, previously volcanic inlet. The shoreline was exposed to high energy wave activity, particularly in the vicinity of Godley and Adderley Heads, while the wave energy decreased to moderate to low levels the further into the Harbour it was assessed.

10.2 Consistent with the level of wave energy the intertidal reef areas on the central to outer Harbour coastline were free of accumulated fine sediment. By contrast, the only two exposed rocky outcrops in the Harbour waters, Parsons Rock and Shag Reef (both in the upper harbour), were affected by accumulated sediment. However, Mr Sneddon reported that a coastal turbidity margin exists, a feature obvious to divers and visible in aerial and satellite photographs of the area. This turbidity is attributed to activity that occurs in relatively shallow depths close to the shoreline where seabed sediment meets the rocky walls. Sediment is stirred up by wave activity and becomes suspended in the water column, including in the upper levels where it is obvious as a turbidity margin. It follows that the shoreline ecology exists in naturally turbid waters.

10.3 The Harbour shoreline adjacent to the channel is at risk of exposure to sediment plumes from dredging activity, so the issue becomes how real is that risk? Mr Sneddon considers that the fine Harbour sediment will be readily re-suspended during dredging, entrained at high concentrations during the overflow phase and relatively slow to settle out of the water column (on account of the small particle size). Hence there is potential for plumes to be transported by ambient currents.

10.4 However, hydrodynamic modelling indicates that dredging plumes will be largely constrained within, or near to, the navigation channel. This results from the largely bi-directional nature of the tidal flows along the length of the Harbour, with little transport towards the shoreline. Shag Reef is an exception, in that tidal flows during dredging

of the swing basin at the inner-most end of the channel may well carry plumes to the Reef. For completeness, we note that Mr Sneddon also considers that the shorelines closest to the disposition grounds will not be affected by sediment plumes on account of the separation distances.

10.5 The shoreline communities: Surveys confirmed a reasonably high diversity of plant and animal life (biota), with 71 taxa recorded in total. This was considered to be consistent with the biota pattern found on similar shorelines in the Banks Peninsula region – a significant finding, indicative of the fact that Lyttelton Harbour biota has fared as well as neighbouring communities, despite harbour dredging over a very long period of time.

10.6 Kelp forest was found to be a consistent feature in -4m water depths, but such large canopy-forming macroalgae became sparse at a depth of 7m. Mr Sneddon put this down to limited light penetration caused by frequent turbid water conditions. Beneath the macroalgae canopy the hard shoreline was found to be dominated by encrusted coralline algae, with green-lipped mussels common and forming dense beds on the northern shoreline of the Harbour. Paua were also found across the shorelines being most abundant at about the 2m depth. These, however, were small in size, only 2.1% being greater than the 125mm limit. No intertidal or subtidal organisms or communities of special interest were found during surveys.

10.7 Overall, Mr Sneddon considered that the shoreline reef communities were stable and structurally complex, and were adapted to, and tolerant of, the natural level of turbidity to which they were exposed. Based on the hydrodynamic modelling and its predictions he foresaw little risk to the shoreline communities, noting that dredge-related sediment will be very similar to natural turbidity sediment and that this is an "important factor".

10.8 Were the modelling predications shown to be wrong Mr Sneddon remained of the view that these "aged plumes" were not likely to occur at sediment concentrations sufficient to cause acute stress. However, if the sediment concentrations were frequent, persistent and exceeded background levels he anticipated:

- an increase in the prevalence of psammophytic (more sediment-tolerant) organisms
- a decrease in erect canopy-forming macrophyte species
- changes to the prevalence and make-up of grazing organisms.

Mr Sneddon doubted that the shoreline communities would be subjected to added turbidity exposure from dredging sufficient to constitute a tipping point; rather the possibility of "community shifts" that are "ultimately reversible" following a return to normal conditions. We understand reversal to be contemplated following the conclusion of a dredging campaign.

10.9 Dr Shaun Ogilvie, provided a report relating to the potential effects on marine mussel farms, but he included some content on wild mahinga kai species as well. With reference to intertidal mahinga kai on the shorelines he observed that modelling data

indicated a negligible change of sediment concentrations from the disposal grounds being transported to shorelines; hence he assessed the risk of adverse effects as negligible. Dr Ogilvie did not comment upon the risk to mahinga kai from sediment plumes generated by dredging, but interestingly he regarded the presence of healthy mahinga kai species (mussels and pāua) on the northern Harbour coastline as significant. Maintenance dredging, typically undertaken annually, results in about 500,000 tonnes of spoil being dumped adjacent to the shoreline but in his opinion this does not seem to negatively impact the mahinga kai population.

10.10 Turbidity triggers: His involvement in TAG ensured that Mr Sneddon had insight into the trigger methodology. He regards setting triggers based on a percentile of background turbidity as inherently defensible, noting that precise knowledge of individual species tolerance to suspended sediment is very limited, so that triggers based on tolerance are not workable. He accepts that the triggers should reflect the amount by which the background can be exceeded before ecological receptors are subjected to additional stress. Mr Sneddon also stressed the proposed monitoring regime in the course of his evidence. He considers a baseline data-set collected over at least a year to be sufficient. Likewise, he regards the information that will be gathered from on-going monitoring as impractical to inform day-to-day operational decisions, but apt to be used in an adaptive management context where longer time frames provide scope for precautionary decision making. Mr Sneddon considers the level of monitoring is sufficient to effectively address the need for a precautionary approach.

10.11 Challenges to the evidence: Before turning to the concerns raised in the shoreline context we wish to comment on the quality of Mr Sneddon's evidence. As should be evident, he made concessions when required and was precautionary in his approach; for example by not assuming the modelling results were infallible, instead he tested the alternative possibility that intrusion of the shoreline by plumes might occur. This lent weight to his testimony, including his conclusions.

10.12 Dr Christopher Hepburn, a marine scientist and associate professor at the University of Otago, provided evidence for Ngāi Tahu. His written evidence raised various concerns, including that rock reef communities, species and the ecosystem services that they provide are very sensitive to both settled and suspended sediment and that "any" additional sediment was likely to result in significant adverse effects. He also ventured the opinion that the reef monitoring programme was not fit for purpose. These aspects suggested a fundamental disagreement with the effects assessment.

10.13 Mr Sneddon responded to these and other concerns in reply evidence. He indicated that in several places his report was misquoted in that fragments of sentences were cited out of context. He also considered that without explanation of the reasoning behind a point of disagreement he was hamstrung and could only provide a limited response. Nonetheless, his reply dealt with the various concerns, indeed met them at a high level of detail. When Dr Hepburn gave evidence at the hearing he indicated that not too many points of difference remained between himself and Mr Sneddon. He said that such differences were matters of emphasis, rather than substance. In these circumstances we find it unnecessary to resolve any remaining issues. Points,

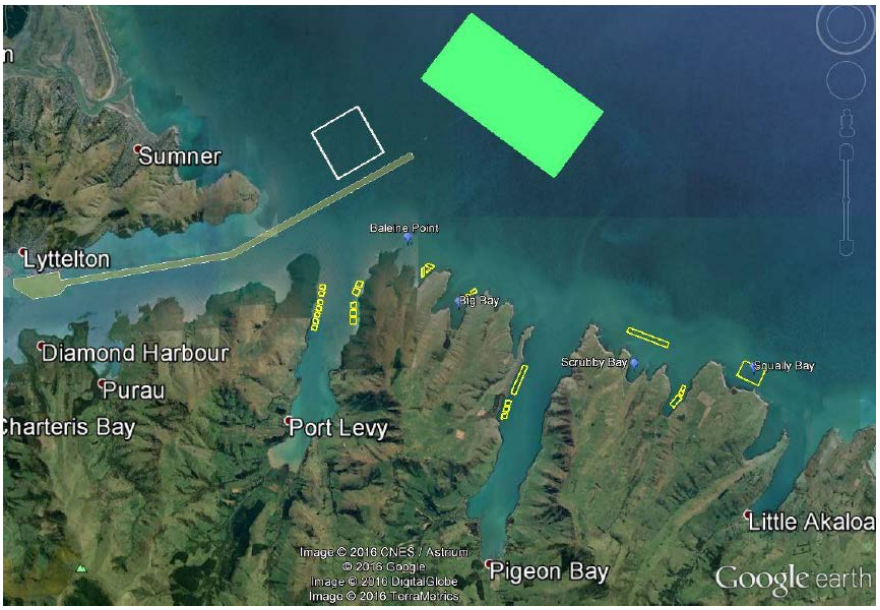
no doubt raised in good faith, fell away in the course of the hearing process. Mr Sneddon's evidence in reply, reflective of his hands-on involvement in the CDP, was persuasive in Dr Hepburn's eyes, as it was in ours.

10.14 The s42A report, in reliance upon the evidence of Dr Bolton-Ritchie, raised concerns about the trigger values, and the adequacy of the subtidal pāua transects. She questioned the efficacy of turbidity based trigger levels, at least their use in isolation, and suggested that alternative parameters (whether physical, chemical or biological) should be considered. Mr Sneddon disagreed. He considered reliance upon ecological effects on particular species as likely speculative, because of lack of knowledge concerning the type of effects suitable to serve as meaningful triggers. Mr Sneddon also doubted whether ecological effects occur quickly enough for use as a trigger. There is an inevitable time lag, by comparison to the use of a proxy such as turbidity that is monitored contemporaneously with dredge-related activity. We note Mr Sneddon's advice that the TAG agreed upon turbidity as the best option in the present adaptive management context.

10.15 Dr Bolton-Ritchie expressed the concern that single 50m long littoral transects at each of six subtidal stations was not sufficient to evaluate changes in pāua abundance and size distribution. Mr Sneddon responded that the transects provide adequate information for assurance monitoring and noted that in the context of a diverse monitoring programme where effort and resources must be spread across a range of areas and species a "more is best" approach is not achievable, nor necessary. We accept this evidence, given with the benefit of his involvement in the multi-disciplinary technical advisory group (TAG) and his involvement in field surveys in the Harbour over a 10 year period.

11.0 Aquaculture Assessment

11.1 Introduction: Dr Shaun Ogilvie, a marine biologist at Canterbury University and a director of an ecological research and consultancy company provided a report, "LPC Channel Deepening Project Assessment of Ecological Effects – Marine Farms" in support of the application. His PhD thesis was on mussel farm ecology. There are 24 commercial green mussel farms along the northern coast of Banks Peninsula between Port Levy /Koukourārata and Squally Bay. These are operated by 6 consent holders. The site map below shows their location (depicted by yellow polygons) in relation to the proposed extended channel and spoil grounds. The maintenance spoil ground (white square) is 2.25km off Godley Head, which provides a sense of scale in looking at the map.



11.2 The farms cover about 123ha, have an individual capital value within a range of $125k to $220k and a total estimated value of between $20m to $29m. Cultivation is on longlines (mussels are suspended in the water column) and dependent on natural food supply. Agriculture NZ figures indicate gross production of about $6.3m per annum based on the last 6 years. There are probably additional sites that are permitted for marine farming, but are yet to be developed.

11.3 Potential Adverse Effects: The main issue is whether sediment plumes from channel dredging or spoil disposal could possibly impact the farms and have an adverse effect on mussels. Dr Ogilvie began by noting that this potential risk must be assessed by reference to the natural turbidity regime of the area. He considers the farm areas exist in a variable, including high, turbidity environment on account of:

- sediment inputs from large braided alluvial rivers prone to flooding, high loess runoff inputs from land; wave induced resuspension of fine sediment from the gently sloping seabed of Pegasus Bay; and sediment inputs into the Bay from estuaries and inlets.
- the predominant south to north sediment flow around Banks Peninsula, especially when: the northerly-flowing current, flooding from tidal streams and south-easterly swells coincide.

This results in highly variable TSS concentrations in the range of 3 to 110 mg/L according to a data-set from July 2007 to December 2013.[12] Dr Ogilvie is of the opinion that the Vision Environment results being gathered at present are providing confirmation of this level range.

[12] Obtained by the Canterbury Regional Council

11.4 Dr Ogilvie then turned to the Beamsley modelling results, in particular those pertaining to the most southerly corner of the large spoil ground, since this corner is closest to the mussel farms. He noted:

- the highest TSS concentrations occur at the seabed, but settle rapidly and are contained within a 300m radius of the release point.
- 10 year plume hind-cast modelling indicated an elliptical plume pattern with the long axis consistent with the predominant ambient current direction.
- in the bottom water layer the 10mg/L contour line generally stays within the mid-water layer within 500m, while plumes in the surface layer are limited and typically below the 10mg/L magnitude.
- it is exceptionally unlikely that even individual sediment particles will be transported closer than 600m from the coastline.

11.5 Despite the level of reassurance provided by modelling, Dr Ogilvie adopted a precautionary approach and broached the potential effects upon mussels should suspended sediment somehow reach the farms. Green shell mussels are filter-feeders. They are sustained by filtering suspended food particles from the water column. Research discussed in scientific literature indicates:

- P.canaliculas (green shell mussels) can cope with TSS concentrations above 1000mg/L and regulate their feeding in this environment.
- this ability to filter feed in silty water is an enhanced capacity of green shell mussels compared to other bivalve species.
- counter intuitively, addition of silt to bivalve diets may enhance growth rates, as a result of increased food absorption associated with a faster clearance rate response to remove the silt.

The final point prompted research and the publication of a paper[13] that suggested a potential for expansion of New Zealand mussel farming through farm development in turbid areas as opposed to a focus on “clear-water” sites.

11.6 Dr Ogilvie is supportive of an extra level of safety through a real time monitoring system to track sediment plumes during dredging activities. He reviewed the details of the proposed system, noted that they were reached following collaboration within the TAG (which included mussel farm representation), and expressed satisfaction with the proposed regime.

11.7 Concerns raised: Few concerns were raised with reference to Dr Ogilvie’s report. Ngāi Tahu sought the establishment of a single offshore disposal ground, being the channel deepening ground (used for maintenance spoil as well, but also located further offshore.) Without entering the relocation debate, Dr Ogilvie simply noted that the two presently proposed spoil grounds have a very low overall ecological effect, such that he cannot see how a reduction to one ground would improve matters.

[13] Hawkins et al, P.canaliculus Feeding Behaviour, 1999

11.8 The Banks Peninsula Marine Farmers, an organisation representative of all the potentially affected farms save for those in Ngāi Tahu ownership, filed a submission raising various points of concern. However, prior to the hearing LPC and the Marine Farmers conferred and negotiated terms that resolved the marine farmers concerns. A new condition 12 in the Channel Deepening Conditions provides for the formation of an aquaculture liaison group (ALG). The membership of the ALG is prescribed, and LPC undertakes to share information and discuss monitoring details with the ALG to "ensure that any effects on (marine farms) are avoided or mitigated" (condition 12.2). In addition, condition 12.10 provides that should LPC not include in its dredging, bio-security or monitoring/management plans any "written recommendation from the aquaculture representatives on the ALG", such recommendation must be lodged with the relevant plan when it is provided to the Regional Council.

11.9 The s42A report recommended that ongoing monitoring should include measuring of mussel survival, growth and condition for 12 months before and after dredging (including wild mahinga kai mussels). While not adverse to this suggestion (his report raised a similar idea), Dr Ogilvie commented that this level of precaution is probably beyond what can be required of LPC.

11.10 We do not accept that specific monitoring of mussel condition should be imposed as a condition of the consents. There is insufficient evidence of an ecological risk to mussels (wild and farmed) to warrant the imposition of such an obligation in this resource consent context. The monitoring of dredging plumes represents an appropriate level of response to any potential risk, even applying a precautionary approach.

12.0 Marine Mammal Assessment

12.1 Introduction: Dr Deanna Clement, a marine mammal ecologist with Cawthron in Nelson, provided the report, "Assessment of Effects on Marine Mammals", that accompanied the application. She has a doctorate in zoology and a special interest in anthropogenic effects of coastal projects on New Zealand marine mammals.

12.2 Marine mammal species: There are seven species that use the coastal waters of Banks Peninsula. These fall into three groups:

- Resident species, that live in the area either permanently or seasonally, being Hector's dolphin and the New Zealand fur seal
- Migrant species, that visit the area regularly but for short periods; humpback and southern whales
- Visiting species, that may wander into the area regularly but for short periods; humpback and southern whales.

Overall the Harbour and its entrance area is not a significant mammal area, save that Hector's dolphin are found in consistently high densities in the Banks Peninsula vicinity (3-6000 individuals) on a permanent basis. The Harbour is considered by Dr Clement to be a low to medium use area.

12.3 Direct risks to mammals: There are considered to be three potential risks to mammals from dredging activity. The first is vessel strikes. Channel deepening will result in more than 2000 vessel movements over each dredging phase of say 9-14 months. However, dredge speeds are relatively slow particularly when dredging and disposal are occurring, and 12-16 kms at most when transporting spoil. Only one dredge-related death was recorded out of all collisions with whales between 1975 and 2002. The risk of vessel strike in the Harbour for baleen whales (the most vulnerable of whales) is assessed as low, given the short duration of whale visits and the low speed of dredge travel. Similarly, a low risk assessment in relation to seals, sea lions, Hector's dolphin and toothed whales was reached; species that are considered likely to detect and avoid a slow moving dredge. These assessments are borne out by the fact that there has been no reported incidence of a dredge strike in the Harbour to date.

12.4 Underwater noise: Underwater noise can affect marine mammals, particularly species that rely on sound to communicate, orientate, avoid predators, and forage. It can cause avoidance behaviour, acoustic masking (obscured ability to hear other sounds) and possible auditory damage. Baleen whales are considered most vulnerable and also most likely to detect noise from dredging. Effects, however, are expected to be minor, being temporary and uncommon. Sound levels from dredging are not expected to exceed injury thresholds, to be of limited duration and dampened by environmental factors (shallow water and sediment prevalence.) Overall, the effect is considered to be less than minor, probably being a temporary avoidance of an area by affected species. To date there has been no evidence of lasting avoidance behaviour in the Harbour as a result of dredging over many years.

12.5 Entanglement. Lines, floats and other equipment lost or deployed in the water can pose a risk to marine mammals. But, dredging activities and equipment are not of a nature considered to pose an entanglement risk. The assessment of risk is extremely low.

12.6 Indirect risks: Dr Clement identified three potential indirect risks. The first is contaminant exposure. Dredging has the potential to stir up, suspend and thereby disperse harmful contaminants. However, the likely effect on marine mammals is assessed as less than minor, because:

- the concentrations of contaminants in the seabed are known to be low
- if re-suspended, they will settle quickly
- insolubility, or low solubility, of most contaminants make for low bioavailability,
- consumption of prey that have been exposed to contaminants is unlikely, given the roving foraging habits of marine mammals.

12.7 A second direct risk is deprivation of prey following destruction of the prey's benthic habitat by dredging. Sole, flounder and red cod are expected to leave the area on account of disturbance and the loss of their food sources. These species are potential prey for marine mammals. However, any impact is anticipated to be of negligible effect. The benthic area to be dredged is small (5% of the total area), spoil smothering

will be localised and temporary, and mammals are well able to forage at similar habitats that remain undisturbed throughout the Harbour and in Pegasus Bay.

12.8 Sediment plumes are assessed to pose a less than minor to negligible risk. This reflects that plumes are transitory, marine mammals (and their prey) are accustomed to natural turbid conditions and also have the ability to escape from plumes if need be.

12.9 We note that Dr Clement assessed both channel deepening, and maintenance dredging, in relation to their potential to cause adverse effects. Her primary and first focus was on channel deepening since it requires the use of a larger vessel and is the more major activity. Accordingly, when assessed the risks associated with maintenance dredging (being the same in nature as those from channel deepening) were shown to be similar, or lower in magnitude than the assessments described above.

12.10 Mitigation: Given that vessel strike and entanglement were potential effects of low probability, but high potential impact, (i.e. death), Dr Clement recommended some best practice mitigation actions. These included recommendations for noise control and safeguards against contaminant effects as well. She recommended:

- an underwater management plan
- a marine wildlife management plan
- an information programme (in lieu of a monitoring programme)

These recommendations entail a range of initiatives, including: visual monitoring for mammals by a designated observer during dredging, cessation of dredging if a mammal is sighted within a safety zone, guidelines for dredge speed limits, actions to evaluate and reduce noise and vibrations, sediment testing pre-dredging and the safe disposal of contaminated spoil. Information gathering was recommended to include liaison with DOC, maintaining records of mammal sightings and the deployment of no less than 4 passive acoustic recording devices underwater. These devices are already in place, and presently gather data on the frequency and presence of marine mammals in the proposed dredging and disposal areas.

12.11 LPC's proposed consent conditions stipulate that the Environmental Monitoring and Management Plan include sections to implement these mitigation measures. The draft plan does so under two headings: Marine Mammal Monitoring (at 5.6) and Marine Mammal Management Plan (6.2); the latter to be prepared by a marine mammal expert experienced in the field of mammal protection.

12.12 Submitter concerns: Dr Simon Childerhouse a marine scientist reported to the Regional Council and, as noted in the s42A report, concluded: "overall,…risks are deemed to be negligible to acceptable with appropriate monitoring and mitigation." Dr Childerhouse also concurred with the assessments contained in Dr Clements' report.

12.13 One submitter, Ms Emma McGrath, raised a series of concerns about potential effects on Hector's dolphins. She also drew attention to the fact that the proposed

spoil grounds fall within the Banks Peninsula Marine Mammal Sanctuary. This was established in 1988, but as pointed out by Dr Clement this was to provide protection in relation to gillnet fishing that was having a major impact particularly on Hector's dolphins. All of the effects raised by Ms McGrath have been assessed by Dr Clement and with regard to the potential effect of locating the spoil grounds in the sanctuary she assessed any associated risk as none to less than minor.

13.0 Marine Fish Assessment

13.1 Introduction: Surprisingly, there were a limited number of submissions raising concerns relating to commercial fishing. A number of submissions from recreational fishers were received, but these largely concerned species found on the Harbour shoreline. The assessment of potential effects on fisheries resources was provided by Dr Sneddon. He pointed out that most commercial fishing activity occurs in waters deeper than 30m; therefore well beyond the depth contour of the larger spoil ground. Dr Sneddon concluded that the two main areas of concern are the near-shore area where flatfish are found and the Harbour itself; in that it serves as a nursery habitat for a range of fish species.

13.2 Flatfish: New Zealand catch data for 2011-2014[14] indicated a flatfish catch totalling 63 tonne taken immediately offshore from Godley Head, being more than a third of the total Pegasus Bay catch over this period. This catch area includes the proposed maintenance spoil ground (but not the channel deepening ground). The main species is the yellow-belly flounder, while elephant fish, skate and gurnard are also found. Dr Sneddon doubts that channel deepening will have any meaningful impact on flatfish given that the area directly impacted is a fraction of the total flatfish habitat within the Harbour and offshore. His assessment also reflects the fact that flatfish are naturally tolerant of elevated suspended sediment levels, given that they reside at the seabed level. Hence, plumes generated from dredging activity are not seen as likely to have any significant effect.

13.3 Dr Sneddon accepts there will be potential for some effect on flatfish arising from utilisation of the proposed maintenance spoil ground. This potential must be assessed in light of these factors:

- the natural tolerance of the species.
- impacts outside the maintenance spoil grounds boundaries are unlikely to exceed those created by normal commercial trawling for catch.
- any loss of actual fisheries area will be limited largely to the 256ha maintenance spoil ground area.
- such loss will be followed by a recovery of affected areas to normal ecological productivity within months to a year from cessation of spoil deposition (noting that spoil is to be spread over the area in a rotational manner).

[14] Maintained by the Ministry for Primary Industries

- if high suspended sediment levels are encountered during deposition the expected response will be fish avoidance of the affected location at least in the short-term

13.4 The harbour habitat: Mr Sneddon's assessment of effects is based on the hydrodynamic modelling. His assumption is that high suspended sediment levels will be confined in extent; limited to the area of the channel with some bi-directional movement of plumes adjacent to the shorelines. This, he considers, will not hamper fish passage up and down the Harbour to any significant degree. On this basis Mr Sneddon concluded that dredging "will have a less than minor impact upon species which make seasonal use of the Harbour for foraging, breeding or nursery aspects of their like cycles."

13.5 Assessment concerns: A Nelson based commercial fishing stakeholder organisation submitted that spoil should be deposited further out to sea where the impact from re-suspension of the fine sediment will not impact on any fisheries resources. Unfortunately this written submission did not confront the fact that most commercial activity in Pegasus Bay occurs beyond the 30m contour line where, presumably, a repositioned spoil ground would need to be located. The submission, and another from Blue Mako Enterprises, expressed strong disagreement to the continued use of Godley Head as a spoil ground. We deal with this contention commencing at 17.22.

13.6 Overall, we find no basis to differ from the assessments reached by Mr Sneddon. The level of potential, and real effects, upon the commercial fishery are not significant, and fall to be finally weighed along-side the effects of the project as a whole.

14.0 Effects on Recreation and Tourism

14.1 LPC engaged Rob Greenway and Associates to assess the effects of the project on recreation and tourism. Mr Greenway who prepared the report is a consultant recreation and tourism researcher, and planner. He has completed over 350 consultancy projects since 1997 and has presented evidence at more than 70 resource management hearings. He has received a number of awards and recognitions for his work and is clearly well qualified to report on this subject.

14.2 The Panel elected not to hear oral evidence from Mr Greenway because his report, Appendix 5 of the application, did not raise any matters which may have affected the outcome of the hearing. However, the subject of the potential effects on surfing was presented to the Panel in some depth by the Surfbreak Protection Society. This evidence is discussed separately below.

14.3 We need not discuss Mr Greenways report in detail, however, we summarise his work in sufficient detail to illustrate the depth and breadth of his investigation.

14.4 Mr Greenway's report extensively covered the subject of the recreational use of the harbour. He reported in considerable depth on marine recreation participation and its

distribution in Lyttelton Harbour/Whakaraupō. He specifically considered the activities of swimming, fishing, surfing, diving, boating tourism, commercial marine recreation and terrestrial recreation. For each activity he examined the expected:

- Changes to water clarity affecting swimming and diving opportunities, and visual amenity; and increased sediment mobility resulting in increased rates of shallowing of the upper Harbour;
- Dredging and sediment effects on marine biota changing the location, quality and scale of the angling and resource in the Harbour and around the offshore spoil disposal sites, as well as inshore shellfish harvesting;
- Occupation of the marine environment by dredging vessels and increased activity as a result of large commercial vessels in the Harbour; including wake effects on boating and shore-based activities;
- Changes to wave and current activity resulting from depth changes in the Harbour, and north and south of the Heads, affecting boating, beach activities and surfing; and
- Effects on marine mammals and birds that may be viewed by recreational visitors to the Harbour.

14.5 In considering these aspects he drew upon other technical reports prepared for the application, the consultation findings of LPC, on line discourse about recreation and tourism in the area, and popular published recreation guides and studies.

14.6 Mr Greenway's overall conclusion was that the effects of the CDP on recreation and tourism will be minor. Notwithstanding, Mr Greenway identified and discussed two issues of relevance to submitters. These were:

- The potential effects on kaimoana and crayfish and
- The potential effects on surf breaks, beaches and turbidity.

14.7 The effects of turbidity on kaimoana species is discussed in more detail in sections 10 and 11 where the evidence of Mr Ross Sneddon and Mr Shaun Ogilvy is reviewed and the conclusion reached that the natural turbidity of the Harbour and Pegasus Bay has resulted in turbidity tolerant resident biota. This, coupled with the conclusion from the modelling outputs that dredging related turbidity is unlikely to impact sensitive shoreline communities, led Mr Greenway to conclude that there is very limited potential for the abundance or quality of recreationally taken species to change.

14.8 The second issue relates to the surf breaks on the northern heads of Lyttelton Harbour/Whakaraupō (Taylors Mistake and further north). Recreational interests in surfing were represented by Mr Boon of the Surfbreak Protection Society. Mr Boon declared that he was not a marine engineer or environmental lawyer, but an experienced surfer who had gained experience across four continents. Mr Boon said that he was speaking for the "10s of thousands of residents and annual visitors of Christchurch that share similar quality-of-life viewpoints relevant to the natural amenities that are in grave danger from this project in its current proposal….." As evidence of this danger, Mr Boon presented a letter from a Mr Ed Aitken of eCoast Marine Consultants and Research, Raglan.

14.9 Mr Aitken's six page letter discussed the modelling work of Dr Beamsley and was critical of it, raising 11 issues about various aspects of the methodology employed. On 28 April Dr Beamsley systematically responded to these criticisms in considerable detail. To do so, he carried out further modelling to test some aspects and provide support to his conclusions.

14.10 It is not our intention to discuss individual points. We were impressed with the well argued and detailed response provided by Dr Beamsley who, having carefully and thoroughly considered and tested the objections raised, confirmed his original advice that the modelling he had carried out was conservative and revealed that the effects of the project on surf breaks are expected to be minor to less than minor.

14.11 Given that Mr Aitken of eCoast did not appear before the panel to allow a direct assessment of his propositions, we are not inclined to accept his views in preference to those expressed by Dr Beamsley.

14.12 Finally, the section 42A report raised a concern about the absence of a procedure to avoid adverse effects on recreation. Mr Pettersson advised in his evidence that the EMMP had been amended to include provisions within the Dredge Management Plan to ensure that the dredge contractor liaises with water sports clubs to identify and resolve any potential conflicts with the dredging program and formal sports events.

15 .0 Dredge Related Effects

This section reviews three direct effects from the presence of dredges operating in Lyttelton Harbour/Whakaraupō.

15.1 Noise: LPC's evidence on this matter was contained in Appendix 18 which was prepared for the LPRP by Hegley Acoustic Consultants in November 2104. The report examined by noise modelling the effects of larger ships using the Port. It concluded that there will be an insignificant change to port noise contours in the Lyttelton Township. It also examined the effects at Diamond harbour and concluded that these too would be insignificant. This application received a submission from Mr Stephen Gardner who expressed concern at the level of noise that might be generated when the dredge vessel bunkered at the oil wharf. Such noise as may occur at this berth from the dredger will be the normal level of ship noise generated by port activity within the harbour. As such it is not a matter for consideration as part of this application.

15.2 The application did not consider noise from the dredger during operation in the turning basin and channels, and no evidence was presented on this matter in the AEE. However, LPC's dredging consultant, Mr Johan Pronk recorded in his evidence that work carried out by the Central Dredging Association compared sound produced by dredging with that produced by normal shipping and found that sound levels emitted by hopper dredgers are in line with that expected from cargo ships travelling at speeds between 8 and 16 knots. This is similar to the noise generated by vessels during normal harbour operations. Accordingly, we agree with the conclusion set out

in the s42A report and we are not concerned that the dredging operations of this project will give rise to increased noise effects within the Harbour.

15.3 Navigation and Safety: LPC's AEE discusses navigation and safety (para 6.149) It notes that maintenance dredging activities have occurred in the harbour without incident for many years. While noting that the larger vessels using the new dredged channel will be more visible, LPC does not see the vessels being significantly different to normal port traffic. The CRC harbourmaster, Mr Jim Dilley considers that any concerns will be manageable under the port's safety systems, and the powers under the Maritime Safety Act. We see no reason to doubt these opinions.

15.4 A submission from Mr Mark Watson raised concern regarding a potential grounding of a large vessel using the channel and suggested the imposition of an environmental bond to cover the costs of such an event. The s42A report discusses this and notes that, while there is provision in the Regional Coastal Environment Plan to require financial contributions, the criteria are not applicable in the posited situation, a view with which we agree.

15.5 In its closing submission, LPC addressed the matter of bonds in greater detail in response to a submission from Mr Hildebrand and the closing submission of Ngāi Tahu, who sought the imposition of a similar bond. In short, LPC's submission was that while the RMA provides for bonds, they are to cover circumstances that are not present here. We also agree with this analysis.

15.6 Natural Character, Visual Amenity and Seascape: LPC commissioned a report from Boffa Miskell to evaluate the effects of the project on natural character, visual amenity and seascape. The report was authored by Mr James Bentley, principal landscape planner for Boffa Miskell. The s42A report noted that there were no submissions expressing concern about the impacts of the proposal on landscape and seascape values. For this reason we need not discuss this matter in any depth. We are satisfied that the Boffa Miskell report was properly and thoroughly prepared and accept the key conclusion: "…it is therefore considered that the natural character, landscape and visual amenity effects of this proposed activity are managed in a way that avoids significant adverse effects and any affects are readily assimilated within a working area of (the) coastal environment."

16.0 Manawhenua Rights, Values and Interests

16.1 The opposing arguments: In addition to concerns raised relating to aspects of the effects assessments and issues relevant to the proposed adaptive management methodology, Ngāi Tahu's submission was underpinned by a contention that the consents should not be granted unless dredging was controlled by conditions that ensured:

"a. There is a net gain in mahinga kai; and

b. Cultural effects are properly recognised and addressed"[15]

In opening submissions Mr Christensen refined the contention somewhat by seeking conditions that "align(ed) with the long term Ngāi Tahu vision to:

(a) protect, restore and enhance the mahinga kai values and water quality of Whakaraupō and Koukourārata and coastal waters; and
(b) exercise kaitiakitanga and rangatiratanga"[16]

16.2 Counsel emphasised that the attainment of this vision, must be clearly articulated in conditions, not left to further and continuing discussions between LPC and Ngāi Tahu. Subsequent paragraphs developed the legal basis for prescribing conditions to the above effect, referred to aspects of the evidence led in support and urged the panel to adopt a draft condition designed to implement Ngāi Tahu's vision.

16.3 Ms Appleyard responded to the contention in both opening, and closing, LPC's case. She indicated that it remained LPC's preference that this matter was dealt with "outside conditions"; by agreement of the parties. She submitted that recent history demonstrated a commitment on LPC's part to establish a co-governance arrangement designed to deliver the enhancement and protection of mahinga kai in Whakaraupō and Koukourārata. Counsel suggested that a "partnership" brokered by LPC and Ngāi Tahu would allow the parties to be "masters of their own destiny" (not reliant on the Regional Council to enforce commitments); and importantly would enable a more holistic approach to future environmental initiatives, not one tied to the context of this dredging application. Her submission also included this: "LPCs' position is that it is committed to reaching agreement with Ngāi Tahu on the formation of a partnership to achieve a net gain in mahinga kai.[17]

16.4 Ms Appleyard referred to evidence said to be supportive of her argument; and to legal issues said to at least limit our scope to engineer a solution of the exact kind sought by Ngāi Tahu. We shall turn to these matters shortly. By way of a fall-back position she accepted that a consent condition may be the only way forward. If the panel was driven to that conclusion, she invited our consideration of a draft condition prepared on behalf of LPC. Ms Appleyard contended the draft was valid at law, whereas that proposed by Ngāi Tahu was not.

16.5 Issues arising: The rival arguments require us to consider a range of issues; some involving evidence that is important but not much in dispute, while other issues are contentious. We shall consider these matters: Ngāi Tahu's historical association with the area, the degradation of mahinga kai, Ngāi Tahu's perception of the channel project, existing recognition of Ngāi Tahu's special relationship with the area; and then turn to the legal aspects and our conclusions.

16.6 Historical consideration: Waitaha, Ngāti Mamoe and more recently, Ngāi Tahu, have occupied Whakaraupō for centuries, especially in the last 300 years where Te Hapū

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[15] Memorandum of Counsel for Ngāi Tahu for Pre-hearing meeting at [70], 23 February 2017

[16] Opening Legal Submissions for Ngāi Tahu, at [8] 5 May 2017

[17] Opening Legal Submissions for LPC, at [08], 2 May 2017

o Ngāti Wheke has since confirmed their right as manawhenua to stand and speak on the values, narratives and resources of the harbour. Banks Peninsula and its harbours were valued for their rich resources. Over the last 150 years Ngāi Tahu continued the pattern of Ngāti Mamoe whereby there were up to 7 settlement sites around Whakaraupō. (Te Pohue/Camp Bay, Purau, Ohinehou, Tamahua, Ōhinetahi, Taukahara and Rāpaki). Most were occupied seasonally to access the kaimoana available from the harbour. E.g. pioke/rig the ika wairua comes into the upper harbour, especially Ōhinetahi, where successive generations have caught these fish and dried them to provide for food throughout the year.

16.7 The takiwa of Ngāti Wheke is cloaked in a rich tapestry of place names that reflects the many layers of occupation over time, the nature of the environment and the enduring manawhenua of Ngati Wheke. For example: Rīpapa (wahi tapu) – a pa designed for musket warfare; Ōhinetahi (wahi tapu) – the original Ngāti Mamoe Pa at the head of the Harbour on a ridge near what is now Governors Bay; Te Papa Whakatakataka (wahi tapu) – a new Pa build by Manuhiri for Ngāi Tahu (now demolished); Te Upoko o Kurī – Witch Hill overlooking Rāpaki, named after tipuna – Kurī who gave his name to Kati Kurī (hapū of Kaikōura); Te Rāpaki o Te Rakiwhakaputa – the principal kaika of Ngāti Wheke named after the first Ngāi Tahu to capture Whakaraupō; Ōketeupoko (The place of the basket of heads), the hills above Ōhinehou (Lyttelton) named in reference to Te Takiwhakaputa's defeat of local Ngāti Mamoe forces at Ōhinehou – the stream and gully located in the Lyttelton township; Ōmawete (the place of Mawete) – Coopers knob. This hill was named in recognition of the defeated Ngāti Mamoe. Mawete was a Ngāti Mamoe rangatira from Manuka Pa.

16.8 The takiwa of Te Rūnanga o Koukourārata reflects traditional concepts of Maori land tenure, following the routes and events of the Makawhiua waka and Ngāi Tuhaitara war party, and enforced again in 1849 by Apera Pukenui during the Port Levy Deed negotiations, when he declared the rights of Kaituna, Waihora and Waikakahi Pa. The takiwa boundaries acknowledge the rangatiratanga of Ngati Huikai from Kaitara pa on the western side of Ki Te Ara Whanui a Makawhiua (the Ngāi Tahu name for Koukourārata Harbour) along a ridgeline to the maunga Te Heru o Kahukura (ancient name for Te Pohue or the Monument) and Te Ahu Patiki and over the Waipuna saddle through Kaituna Valley and along the shores of Te Waihora to Waikakahi, and then inland to the summit along the ridgeline to Pohatu and along the northern coastline back to Koukourārata.

16.9 Koukourārata was the first landing place of the celebrated waka taua Makawhiua and the Ngāi Tuhaitara war party Te Taua Tuawhiti. After escapades to the north, the Makawhiua set sail from Kahutara to Kaiapoi and onto Te Pataka o Rakaihautu. The waka made its first landfall at what is now named Horo-Maka and Koukurārata. A council of war was held during which the mauri of Koukourārata was placed in the waters there. This same council laid plans for the usurpation of the Ngati Mamoe on Te Pataka o Rakaihautu. The waka Makawhiua was launched from the island Horomaka (meaning the "dispersal of Maka") and the party made their way around the eastern bays. This ultimately resulted in the configuration of the hapu today and the ensuing of its manawhenua status; this through the first marriages and the resulting birth of children.

16.10 Evidence provided by elders who have a lifetime of experience of Whakaraupō and Koukourārata emphasised cultural aspects of importance to Ngāi Tahu. Their evidence explained mahinga kai as being the natural resources (kai) and the places and practises where they were worked (mahinga). The Ngāi Tahu Claims Settlement Act 1998 defines Mahinga Kai as "the customary gathering of food and natural materials and the places where those resources are gathered". Mahinga kai was one of the Nine 'Pou' of the Ngāi Tahu Claim. Mahinga kai forms the basis of Ngāi Tahu's traditional economy and the backbone of Ngāi Tahu's social fibre and culture. Tikonga refers to customs, values and practices; and plays a key role in protecting and enhancing mahinga kai. Customary norms have been handed down from generation to generation and include:

- take what you and your whanau need, not what you want;
- give away a portion of what you take to those who can't gather, including Kaumatua;
- leave the breeders, as they will ensure the resource remains over the long term;
- harvest kai when it's at it prime;
- clean above the high water line;
- replace the rocks the way they were found.

16.11 They also spoke of kaitiakitanga, being guardianship, preservation, conservation, fostering, protecting, or sheltering. The practice of kaitiakitanga at an individual level was learnt at an early age, reflected in the tikanga that governed how mahinga resources were managed. At another level kaitiakitanga is about the philosophy and practices of sustainable resource management, something developed through the generations, to protect and where necessary, enhance the mauri of a place or resource for the benefit of present and future generations. Mauri refers to the life force in living things and land or the essence that binds the physical and spiritual elements of all living things together, generating and upholding life. Hence, each type of water has a unique mauri (as does every human being and element of the natural environment). Water types include:

- waitai sea water
- waimaori freshwater, streams, rivers
- waitapu sacred waters.

The mauri of Whakaraupō comprises many elements, and Ngāi Tahu holds that protection of mauri requires an holistic approach, expressed as ki uta ki tai.

16.12 The elders also emphasised rangatiratanga, often translated as meaning political authority and leadership. Ngāti Wheke holds manawhenua manamoana over the Whakaraupo catchment and has the right, and obligation, to protect and advocate for Whakaraupō. They have aspirations for and believe they can contribute to the practical solutions for Whakaraupo regarding this application. To ensure that outcomes appropriate for the harbour are achieved, they advocate for the enhancement of mahinga kai.

16.13 The degradation of mahinga kai: In addition to explaining the matters above the elders (Dr Matea Gillies, Henry Couch and Peter Ramsden whose evidence pertained

to Koukourārata) outlined their concerns about the state of the Harbours today, as compared to in earlier times. Each speaker drew on different experiences and examples in detailing their concerns, but in the end result the message supported by photographs and props, was similar. Their evidence conveyed:

- gathering mahinga kai was an activity that began in early childhood and continues throughout a lifetime.
- children were taught by example and instruction, usually from parents and relatives, the tikanga of good gathering
- a few generations ago kai was plentiful in Whakaraupō, with diversity of species including pāua, kina, kūtai (mussels), koura (crayfish), tio (oysters), tipa (scallops), tuaka (cockles); as well as hoka (red cod), moki, mārari (butterfish), pioke (rig), pātiki (flounder) and sharks
- seaweed was also plentiful along the Harbour shorelines
- today, by comparison, the diversity and supply of seafood is significantly diminished, as is the flora upon which marine species depend.
- increasing sedimentation levels throughout the Harbour have impacted the habitats, and hence mahinga kai
- this process of sediment accumulation was compounded by effects from construction of the Cashin Quay breakwater commenced in the late 1950's
- Whakaraupō, the principal mahinga kai within Ngāti Wheke's takiwa (area) and taonga of importance to their welfare, is now a limited resource and increasingly vulnerable.

Listening to this evidence it was plain that what was spoken was heartfelt and that a sense of personal responsibility for the present state of Whakaraupō in particular, prevailed.

16.14 The witnesses acknowledged that the incremental build-up of sedimentation in Whakaraupō was attributable to run-off in the main, but described a "sense" or "instinct" that the breakwater was also a significant contributor. This is about the only contentious aspect of their evidence, since otherwise we accept each element of the evaluation set out in the previous paragraph.

16.15 Ngāi Tahu's perception of the project: In the end result this aspect was essentially dealt with through the evidence of Mr Tasman Gillies, a zoologist (with a special interest in blackfoot paua), a member of the TAG and a tangata tiaki[18] for Ngāti Wheke appointed by the Minister for Primary Industries. He works for Te Rūnanga o Ngāi Tahu as an environmental advisor. His evidence, however, was given in a personal capacity and from the perspective of a young man concerned about the condition of Whakaraupō, in the long term; indeed on an inter-generational basis.

16.16 His evidence may be summarised in these prepositions:

- he had never experienced mahinga kai in a similar manner to his tupuna

[18] Person authorised under the Fisheries Act 1996, to issue permits to gather kai in excess of a recreational take, and carry out other similar responsibilities

- the goal is to restore mahinga kai levels in Whakaraupō through kaitiakitanga, as a shared responsibility of Ngāti Wheke to ensure the heritage of future generations
- that the deepened and lengthened channel will be a permanent scar running the length of Whakaraupō; compounded by sediment plumes in the Harbour and spoil smothering the Papatūānuku (land)
- the project and subsequent maintenance dredging will degrade the mauri and mahinga kai of Whakaraupō
- utu, a concept concerned with balance and reciprocity, is a principle of kaitiakitanga
- a net gain in mahinga kai would be utu for the permanent insult to Whakaraupō
- LPC will gain from the channel project at the expense of the environment, and should reciprocate through facilitating a net gain.
- the mauri of Whakaraupō will be restored by a mahinga kai enhancement commensurate with the scale of the effects from the project (this not being the place to "right past wrongs").
- LPC's commitment to enhance mahinga kai must match the duration of any consents.
- rangatiratanga and kaitiakitanga go hand in hand, meaning that Ngāti Wheke will exercise authority in relation to decisions involving the mauri and mahinga kai of Whakaraupō

16.17 Mr Gillies vision is of an integrated enhancement programme that will achieve net gain and enable Ngati Wheke to exercise kaitiakitanga. Such gain will be in addition, but complementary, to any gains from the existing Whakaraupō Catchment Management Plan and the Kaimoana Management Plan. The programme will require a number of elements:

- access to enable the gathering of mahinga kai.
- Mātauranga, the use of local knowledge and experience to guide the processes.
- Monitoring and research
- Education
- Restoration initiatives
- Compliance requirements

Mr Gillies noted that the leadership role must lie with Ngāi Tahu since LPC is not manawhenua, nor does it have any mandate under the Fisheries Act, 1996. He also acknowledged that "in the absence of clarity about the effects (of the proposal), I don't think that precise detail can be provided on what a net gain will encompass". We understand that such absence of clarity is founded on the evidence provided by Ngāi Tahu's expert witnesses; a matter to which we will return later.

16.18 Existing recognition of a special relationship: The written and oral witness evidence of Ngāi Tahu's special relationship with Whakaraupō does not stand alone. It is supported by various resource management provisions, the creation of mātaitai and

the establishment of programmes for the restoration of the Harbour in which Ngāi Tahu is closely involved.

16.19 Relevant provisions: Part 2 of the RMA recognises matters that must be taken into account by decision –makers, including:

- The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga. (Section 6(e))
- The protection of protected customary rights. (s6(g))
- Kaitiakitanga (s7(a))
- The principles of the Treaty of Waitangi (Te Tiriti o Waitangi). (s8)

Section 104 further directs decision- makers to have regard to national environmental standards, regulations, policy statements (national and regional) and RMA plans; together with ”any other matter” considered relevant and reasonably necessary to the determination of a resource management application. In this instance there is a plethora of material to be considered. Such sources have been referred to in LPC’s application, the S42A report and by Ngāi Tahu in both evidence and submissions. We shall not refer to every source, since some provisions are duplicated and other matters have been referred to already.

16.20 The New Zealand Coastal Policy Statement 2010 recognises the traditional and continuing cultural relationship of tangata whenua with coastal environments (policy 2(a)), the need to take account of Iwi Management Plans (policy 2(e)) and the need to provide opportunities for tangata whenua to exercise kaitiakitanga over waters and fisheries in the coastal environment (policy 2(f)). Policy 21 entitled “Enhancement of Water Quality: requires that priority is given to improving degraded water quality by engaging with tangata whenua to identify areas of coastal waters of particular interest (cultural sites, waahi tapu, taonga and values such as mauri) so that remediation or mitigation of adverse effects on those areas and values is achievable. The direct relevance of these policies is self- evident.

16.21 The Regional Coastal Environment Plan for the Canterbury Region has already been referred to, in particular Chapter 10 which was introduced to address Lyttelton Port earthquake recovery activities. Objectives and policies provide for the Port’s recovery; while policy 10.1.4 requires LPC to ensure that the values of Whakaraupō are recognised, adverse effects are minimised as far as possible, best practice is adopted and “effort is made to achieve a net gain in mahinga kai”. Policy 6.1 requires adoption of a precautionary approach where effects are unknown or little understood; or the functioning of marine ecosystems and coastal processes are poorly understood.

16.22 Other matters: The Ngāi Tahu Claims Settlement Act 1998 designates Te Tai o Mahaanui (Banks Peninsula and Selwyn) to be a statutory acknowledgement area. This means that Ngāi Tahu’s particular cultural, historic, spiritual and traditional association with the area has been recognised by the Crown. RMA decision-makers must have regard to this in deciding whether and to what extent Te Hapū o Ngāi Wheke, Te Rūnanga o Koukourārata, and Te Rūnanga o Ngāi Tahu are affected by this application.

16.23 A significant part of the inner Harbour comprises the Rāpaki Mātaitai Reserve that was established in 1998 (the first mātaitai in New Zealand) under the Fisheries Act 1996. This means the reserve is recognised as a customary fisheries area where commercial fishing is prohibited; and control and responsibility for the conservation, protection and restoration of the customary resource rests with tangata tiaki. We note that an application to extend the reserve to cover about two thirds of the Harbour has been filed, but a decision is still pending[19]. The Koukourārata Mātaitai Reserve is across the whole of the Harbour and was recognised in December 2000.

16.24 The Mahaanui Iwi Management Plan 2013 is a collaborative manawhenua planning document prepared by Te Hapū o Ngāti Wheke and Te Rūnanga o Koukourārata with three other Papatipu Rūnanga from the area south of the Hurunui to the Hakatere River. The plan is a written expression of kaitiakitanga and rangatiratanga. It provides planning and policy frameworks including for the preparation of cultural impact assessments (CIA's). The Plan contains sections devoted to Whakaraupō and Koukourārata. These include policy statements relating to the coastal marine environment. Numerous themes are covered ranging from the wahi taonga status of particular areas to the management of kaimoana according to traditional values and tikanga.

16.25 Two CIA's were prepared in relation to LPC's application by Ms Dyanna Jolly, the first dated May 2014 and the second Sept 2016. The update provides a detailed account of progress and changes since 2014, records the consultation process, agreements and actions resulting from consultation; and identifies key issues of concern outstanding as at the report date. Four of the key issues were:

- Whakaraupō and Koukourārata are highly valued as mahinga kai and this concept remained the driver for assessing the effects of the proposal.
- Concern persisted that localised and cumulative sediment-induced effects threatened mahinga kai
- To provide certainty in relation to the extent of suspended sediment disposal the spoil ground (singular) should be located further offshore and in deeper water.
- A collaboratively developed strategy to promote a whole of harbour plan to address all issues affecting Whakaraupō and Koukourārata in an effective manner, was needed.

Each of these themes remains contentious today, not having been resolved in recent months despite ongoing consultation.

16.26 Finally, we note Ngāi Tahu's central involvement in two current initiatives intended to address what might be termed the health of the Harbour over time. The first is the Kaimoana Management Plan associated with the Te Awaparahi Bay reclamation. This initiative was mentioned only in passing, but as the name implies it is an environmental programme to reinstate the kaimoana resource that will inevitably be

[19] A Gazette Notice of 22 June 2017 declared and defined the area of a new Lyttelton Harbour/Whakaraupō Mātaitai Reserve that will come into force on 20 July 2017

affected during development of the reclamation area that is required to increase container handling capacity.

16.27 The Whakaraupō Catchment Management Plan is rather more far reaching. It is a product of the Port Recovery Plan. Following approval and promulgation of the Plan by the then Minister of Canterbury Earthquake Recovery in 2015, representatives of the Regional Council, LPC, Te Hapū o Ngati Wheke, Te Rūnanga o Ngāi Tahu, the Christchurch City Council and Mātaitai tangata tiaki agreed on a governance structure and process for developing and implementing an integrated management plan for Whakaraupō. This has occurred, although progress is still at a formative stage. For the moment we simply note these developments and Ngāi Tahu's involvement. We shall return and deal with the significance of the Management Plan shortly.

16.28 The above review of legislative provisions and the extent of Ngāi Tahu's commitment to, and involvement in activities concerned with, the health of the Harbour speaks for itself. We are in no doubt as to the level of commitment, sense of responsibility and resolve of Nagai Tahu to improve and safeguard Whakaraupō on account of its mahinga kai value and their long association with it. The same may be said in relation to Koukourārata; based on the evidence of Mr Ramsden; but in the context of this resource consent application we see differences as well. We shall explain these shortly.

16.29 A net gain in Mahinga Kai: Earlier we highlighted the essential difference between counsel for LPC and Ngāi Tahu concerning the contention that the application should not succeed unless a net gain in mahinga kai was assured. By a Minute dated 21 April 2017 we asked counsel whether we were empowered to decline the application simply because a net gain was not assured and invited submissions on this issue in the course of opening remarks at the hearing, including reference to any relevant planning provision or legal precedent. Helpful submissions were provided.

16.30 These included a focus on another Supreme Court decision: Environmental Defence Society Inc. v New Zealand King Salmon Company Ltd[20] a companion case to the King Salmon decision referred to earlier (at 4.1). These two cases were heard together and separate decisions were delivered at the same time. The Environmental Defence decision concerned the approach that must be taken by decision-makers in determining an application for a plan change. King Salmon sought, and obtained, a plan change that enabled the Company to seek aquaculture resource consents for areas in the Marlborough Sounds where salmon farming was previously a prohibited activity. The Plan Change altered the activity status to discretionary.

16.31 The Supreme Court overturned this plan change on the grounds that an incorrect approach had been taken, in that what is termed an "overall judgement approach" based on the "purpose and principles" in Part 2 of the RMA was adopted. This paragraph was central to the Court's thinking:

> "[30] The RMA envisages the formulation and promulgation of a cascade of planning documents, each intended, ultimately, to give effect to s5, and to Part 2 more generally. These documents form an integral part of the

[20] Environmental Defence Society Inc. v King Salmon Company Ltd [2014] NZSC 38

legislative framework of the RMA and give substance to its purpose by identifying objectives, policies, methods and rules with increasing particularly both as to substantive and locality.

Because the plan change decision was based on an overall judgement approach, informed by the Part 2 provisions, the Court considered that the more specific provisions of the plan itself, relating to the actual locality in question, had been down-played. Hence, the plan change was overturned.[21]

16.32 This emphasis on the plan provisions was, however, made subject to three caveats. If the provisions:

- were invalid, that is unlawful,
- did not "cover the field', or
- were uncertain as to their meaning

then it may be necessary and of assistance to have recourse to the Part 2 purpose and principles.[22]

16.33 Subsequently, in Davidson Family Trust v Marlborough District Council[23] the High Court held that the Supreme Court reasoning applied in the present context of a resource consent decision as well. This required a focus on s104(1):

[104 Consideration of applications

(1) When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2, have regard to–

(a) any actual and potential effects on the environment of allowing the activity; and

[[(b) any relevant provisions of—

(i)a national environmental standard:

(ii) other regulations:

(iii) a national policy statement:

(iv) a New Zealand coastal policy statement:

(v) a regional policy statement or proposed regional policy statement:

(vi) a plan or proposed plan; and]]

(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.

[21] Young J dissented on the grounds that provisions in the plan were in conflict, and that this justified resort to Part 2 to resolve any ambiguity.

[22] At [38] of the judgement

[23] R J Davidson Family Trust v Marlborough District Council [2017] NZHC 52

Standing in the shoes of the consent authority we must, subject to Part 2, have regard to all matters specified in (a), (b) and (c). Both counsel followed the reasoning in Davidson and we consider we should as well. Although s66 of the RMA, which guides how plan, and plan change, decisions are to be approached is expressed in different terms to s104, we see no basis to doubt the conclusion reached in Davidson.

16.34 Provisions relevant to mahinga kai: Counsel differed somewhat in relation to this issue. Mr Christensen began by considering two policies in the New Zealand Coastal Policy Statement, namely policy 2 and policy 11. These include:

Policy 2 The Treaty of Waitangi, tangata whenua and Māori heritage	In taking account of the principles of the Treaty of Waitangi (Te Tiriti o Waitangi), and kaitiakitanga, in relation to the coastal environment: (a) recognise that tangata whenua have traditional and continuing cultural relationships with areas of the coastal environment, including places where they have lived and fished for generations;…….. (f) provide for opportunities for tangata whenua to exercise kaitiakitanga over waters, forests, lands, and fisheries in the coastal environment through such measures as: i. bringing cultural understanding to monitoring of natural resources; ii. providing appropriate methods for the management, maintenance and protection of the taonga of tangata whenua; iii. having regard to regulations, rules or bylaws relating to ensuring sustainability of fisheries resources such as taiāpure, mahinga mātaitai or other non commercial Māori customary fishing;
Policy 11 Indigenous biological diversity (biodiversity)	To protect indigenous biological diversity in the coastal environment:……. b. avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:…….. iv. habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes;

While she acknowledged these policy statements Ms Appleyard doubted that they assisted in relation to determining whether a net gain was a contemplated outcome.

16.35 Most attention was focussed upon the provisions in the Regional Coastal Environment Plan (for the Canterbury Region).

Objective 7.1 relevantly states:

Enable present and future generations to gain cultural, social, recreational, economic, health and other benefits from the quality of the water in the Coastal Marine Area while:

a) …….
b) …….

c) Safeguarding, and where appropriate, enhancing its value for providing mahinga kai for Tangata Whenua

Objective 10.1 provides for "the expedited recovery of Lyttelton Port" but subject to "managing any adverse effects of recovery activities on the ecological, recreational, heritage, amenity and cultural values of Whakaraupō/Lyttelton".

And, policy 10.1.4 (4) is perhaps the most specific of all:

Recognise that the recovery of Lyttelton Port, including reconfiguration, will result in some adverse effects on the environment that cannot in all circumstances be avoided or mitigated, but that the owner or operator of Lyttelton Port will undertake recovery activities while ensuring that:…….

4) Effort is made to achieve a net gain in mahinga kai.

Finally, rules 10.12 and 10.18 which relate to the disturbance from dredging and maintenance spoil deposition, respectively, both specify as a matter of discretion

- "The effects on cultural values, particularly mahinga kai."

16.36 Ms Appleyard submitted that neither singly, nor in combination, did any of the above provisions suggest that attainment of a positive gain in mahinga kai fell within the purpose and principles of the RMA. She implied that to require such an outcome upon pain of refusing a consent would be antithetical to the core principle of sustainable management. The very language of s15 – sustaining, safeguarding, avoiding, remedying and mitigating – conveys that the core purpose of the Act is to manage resources such that social, economic, cultural and personal wellbeing is provided for, and at the same time resources, air, water, soil, ecosystems and the environment are sustained. This contemplates that a balance is to be struck.

16.37 Counsel added that nowhere in the Act is there a requirement to have no adverse effects, let alone achieve an overall positive effect related to an activity. Ms Appleyard also posed two questions: what does a net gain in mahinga kai mean? How would the gain be measured from the starting point of the Harbour environment as it is today? She also emphasised that the current condition of the Harbour included those effects resulting from the exercise of the existing maintenance consent, that these effects were "part and parcel" of the existing environment.

16.38 Mr Christensen began by disputing the aside of Ms Appleyard that there was no scope to regard the provisions in the New Zealand Policy Statement or the Regional Coastal Environment Plan as unlawful, incomplete or uncertain. He described the provisions as incomplete in the sense that "while providing considerable direction, (they) do not mandate the outcome with respect to mahinga kai." There was not "complete prescription", which he said was not a criticism, rather a recognition that the provisions provide parameters for discretionary decision making.

16.39 We disagree. Policy 10.1.4 (4) in the Environment Plan (see 16.35) could hardly be more specific or prescriptive. It provides that effort is to be made to achieve a net gain in mahinga kai. The extent of the obligation is clear, even if measuring a net gain may be problematic. Hence this is not a situation where resort to Part 2 is required because the provisions do not cover the field. Nor for that matter can we see how resort to the purpose and principles of the Act would assist. How, as decision-makers, would we elevate an obligation to try to achieve something into a requirement to actually achieve a net gain – an issue not broached in the course of submissions.

16.40 The submission for Ngāi Tahu urged that the relevant effects were both cultural and physical ecological effects, and that we had a discretion, including by resort to the "any other matter" clause (s104(1)(c)), to conclude that a net gain in mahinga kai was required "to meet the overall test of sustainable management", and then to impose a condition to that effect. This seems to be a submission based on the assumption that the policy provisions are incomplete, resort to Part 2 is therefore required and an overall judgement approach is to be applied. Again, we disagree. First, the policy provisions are not incomplete for the reasons above. Second, we do not understand the Supreme Court to have approved a return to an overall judgement approach where provisions are invalid, incomplete or uncertain. Rather resort to the purpose and principles of the Act is mandated on the basis that it may assist in interpreting and applying the particular policy provisions, despite their deficiencies.

16.41 We therefore reject the proposition that absent an imposed condition requiring actual achievement of a net gain we should decline the application. Nonetheless, LPC remains subject to an onerous obligation to ensure that effort is made to achieve a net gain in mahinga kai. This policy, we think, provides both guidance and scope to fashion a way to enhance the health of the Harbour. We also consider this approach avoids the difficulty inherent in defining a net gain, since ensuring that genuine effort is made does not have the same quantitative connotation.

16.42 <u>The exercise of kaitiakitanga and rangatiratanga:</u> This, the second limb of Ngāi Tahu's vision for Whakaraupō, is not contentious. The concepts of kaitiakitanga and rangatiratanga are recognised in Part 2 of the Act, and the need to give expression to them in the marine coastal environment is emphasised in both the New Zealand Coastal Policy Statement and the Regional Coastal Environment Plan. We have already found that Te Hapū o Ngāti Wheke from their base at Rāpaki have, and already exercise, rangatiratanga over Whakaraupō. It remains to determine how best to implement the objectives and policy of the Regional Plan to both preserve the "cultural, social, recreational, economic health and other benefits from the quality of the water in (Whakaraupō)"[24], for people in general, while also enhancing and endeavouring to achieve a net gain in mahinga kai for Tangata Whenua[25].

16.43 Although we accept that there is some basis to include Koukourārata as an additional area within the auspices of a management plan alongside Whakaraupō, the LPC project will have no direct impact in Koukourārata. At most there is a remote risk that

[24] Regional Coastal Environment Plan, Objective 7.1 and Policy 10.1.4(4)

[25] Regional Coastal Environment Plan, Objective 7.1

suspended sediment may reach the entrance, or possibly enter, Koukourārata. But modelling and monitoring to date suggest that there will not be adverse effects within Koukourārata. Accordingly, we find there is no basis and that it would not be reasonable to direct that any management plan extends to both Harbours.

16.44 Ngāi Tahu's broader submission: Mr Christensen advanced a broader, and alternative submission not based on the planning provisions per se and whether they directly supported a net gain in mahinga kai. Rather, as we understood him, he advanced these propositions:

- planning provisions alone do not define the breadth of our discretion in reaching a decision on the application,
- s104(1) requires us, subject to Part 2, to have regard to:
  - (a) any actual and potential effects on the environment….
  - (c) any other matter the consent authority considers relevant and reasonably necessary to determine the application,
- hence, positive effects such as a net gain can be considered in the discretionary evaluation under either (a) or (c),
- and, the Panel may decline the application if it concludes that a net gain in ecological values is required to meet the "overall test" of sustainable management and a condition to that affect is not offered or accepted by LPC.[26]

At this point counsel's submission referred to biodiversity offsets and environmental compensation, noting that it is within the panel's discretion to decline an application should we decide an offset or compensation is necessary and LPC does not offer, or accept the need for one.[27]

16.45 In our view the broader submission advanced by Mr Christensen is in reality an invitation to adopt an overall judgement approach by another name; an exercise of discretionary judgement approach. By resort to s104(a) and (c) counsel argued that our discretion is very broad, and extends to requiring a net gain in mahinga kai if we decide that physical or cultural effects warrant it. We do not consider this suggestion appropriate. In effect it invites us to ignore or a least downplay, the significance of the planning provisions most relevant to Whakaraupō. To do so would be contrary to the Supreme Court decision in the Environmental Defence Society case; see for example:

> [151]…Reflecting the open-textured nature of Part 2 Parliament has provided for a hierarchy of planning documents the purposes of which is to flesh out the principles in s.5 and the remainder of Part 2 in a manner that is increasingly detailed both as to content and location. *It is these documents that provide the basis for decision making, even though Part 2 remains relevant.*" (emphasis added)

In our view the words used in the Regional Council Environment Plan, policy 10.1.4, represent the bottom line. LPC must ensure that effort is made to achieve a net gain. We infer that these words were deliberately chosen because of the difficulty in

[26] Ngāi Tahu opening submission, 5 May 2017, at [55-56]

[27] Submission [57-59]

establishing an actual gain. This difficulty, incidentally, was acknowledged by Ngāi Tahu both in evidence and submissions. To subscribe to a broad discretionary approach would require us to both disregard the reasoning in Environmental Defence Society and subvert the policy direction in Policy 10.1.4.

16.46 Turning to the issue of environmental offsets or environmental compensation we understood Mr Christensen to raise these concepts as "positive effects" usually offered by an applicant to offset an adverse effect of the proposed activity. He emphasised the distinction between mitigation and an offset. The former moderates or alleviates the impact of some adverse effect of the subject activity. By contrast an offset is a positive contribution, unrelated to the activity, offered by an applicant to offset an acknowledged adverse effect of the proposed activity. In discussing this distinction Fogarty J. said this:

> "(to) mitigate is to alleviate, or to abate, or to moderate the severity of something. Offsets do not do that. Rather, they offer a positive new effect, one which did not exist before".[28]

For example, an applicant's offer of money or land because of an adverse effect of the proposal would be an offset. Fogarty J's judgement also suggests that an act of this kind is more properly described as "environmental compensation" (not an offset), with which we agree.

16.47 Mr Christensen referred to cases where environmental compensation had been paid, including Te Runanga o Ngāi Te Rangi Iwi Trust v Port of Tauranga Ltd[29] a case similar to this one in that the Port sought consents to enlarge its navigation channel, while the Iwi Trust opposed the application on account of adverse cultural effects upon the mauri of the harbour, a waahi tapu site and mahinga kai, amongst others. Ms Appleyard acknowledged the concept of environmental compensation, but also emphasised that it was ordinarily proposed by an applicant confronted by some unavoidable and significant adverse effect of the proposed activity. She did not accept that this was the situation here, but repeated that LPC was committed to addressing cultural effects in the manner previously described.

16.48 We do not find the excursion into the realm of environmental compensation helpful. LPC has not offered it as such, but remains committed to the formation of a partnership with Ngāi Tahu to achieve a net gain in mahinga kai. We cannot impose an environmental compensation type condition (other than under s108 (10), which has not been relied upon and may not apply anyway.) As we understood Mr Christensen's argument he contended we should decline the application if we concluded that sustainable management could only be achieved if some form of environmental compensation was offered. We are not persuaded of this principally because we are satisfied that there is a way forward that does achieve sustainable management.

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[28] Royal Forest and Bird Protection Society v Buller District Council [2015] NZHC 1346 at [72]

[29] Te Runanga o Ngāi Te Rangi Iwi Trust v Port of Tauranga Limited [2011] NZENVC 402

16.49 The way forward: Two members of this panel were also members of the panel that conducted the hearing and provided a report entitled "Preliminary Draft Lyttelton Port Recovery Plan (Recommendations of the Hearing Panel)", dated 6 July 2015. The first recommendation in the report was focused on the need for a Whakaraupō/Lyttelton Harbour Management Plan. Identification of this need as the first priority was deliberate. Our discussion on this aspect included these two points:

- "That the health of the harbour is of such importance that it should not be left to a foreshadowed agreement.
- That any harbour management initiative should be an integral part of the recovery, not a promised future commitment."

As we shall elaborate shortly, the recommendation was included in the Recovery Plan promulgated in November 2015 by the Canterbury Earthquake Authority (CERA).

16.50 Evidence at the 2015 hearing was similar to that presented to us in relation to this application. Ngāi Tahu took the lead role, but supported by community organisations speaking on behalf of residents (Governors Bay, Diamond Harbour etc.) The panel noted that "the strength of feeling about the need to manage the health of the harbour (was) something shared by all of the harbour communities"; and that it was "essential that the recovery plan proceeded in tandem with a serious, well-resourced and long term initiative to investigate and address the health of the harbour."

16.51 The evidence from Ngāi Tahu at this hearing reaffirmed and, if anything, heightened the need for and importance of a long term management plan. Tasman Gillies spoke of dredging inflicting a "permanent scar" along the length of Whakaraupō. A scar is something often seen, and unsightly. The enlarged navigation channel will not be seen. Perhaps a better description of the effect is an "environmental insult" since it is the potential impact upon flora and fauna that is of the most concern. Capital dredging in at least two stages, followed by regular maintenance dredging, will give rise to insults to the harbour environment on a recurrent basis, albeit insults adaptively managed by LPC as best it can.

16.52 Before us the evidence concerning this insult was focussed in nature, being specifically directed to the activities of dredging and spoil disposal, but this was also a hindrance. The reality is that LPC's application concerns but one aspect of the Port recovery. Development of the container reclamation, involving a probable 23.5ha addition to the existing Te Awaparahi Bay area, followed by the development of the container facility will produce adverse effects as well, including visual effects and potentially light and noise issues for some harbour residents. Ideally, all effects of the recovery should be assessed cumulatively, particularly when considering an issue such as the health of the harbour. This advantage was enjoyed by the previous panel, but not this one. Instead we must consider dredging effects alone as the RMA requires.

16.53 The Port Recovery Plan described the Management Plan initiative as follows:

"Canterbury Regional Council, Lyttelton Port Company Limited, Te Hapū o Ngāti Wheke, Christchurch City Council and Te Rūnanga o Ngāi Tahu with Tāngata Tiaki

have agreed to work together to develop a catchment management plan for the Whakaraupō/Lyttelton Harbour in accordance with the philosophy of ki uta ki tai (from the mountains to the sea). The group will consult with other stakeholders and agree on the organisational and governance structure and process for developing and implementing the catchment management plan. Canterbury Regional Council will facilitate the initial discussions on the structure and process but the longer-term leadership is to be agreed. A key objective of the Whakaraupō/Lyttelton Harbour Catchment Management Plan is to restore the ecological and cultural health of Whakaraupō/Lyttelton Harbour as mahinga kai. It will also address other environmental, cultural and social concerns, including the needs of recreational users, was well the needs of a working port. Canterbury Regional Council has made funding available for the development of the Whakaraupō/Lyttelton Harbour Catchment Management Plan through its Long-Term Plan 2015-25. Lyttelton Port Company Limited has also committed to provide funding, and funding from other organisations will be identified. It is proposed that the initial agreement on the organisational and governance structure, as well as on the process for developing and implementing a catchment management plan and funding, will be decided by December 2015. A stocktake of existing traditional and scientific knowledge will be completed by June 2016 and the Whakaraupō/Lyttelton Harbour Catchment Management Plan developed by December 2016."

Although the date for finalisation of the catchment management plan is now November 2017, we received positive reports on progress from Donald Couch, a member of the Partners Working Group and Ms Bianca Sullivan, who represents the Regional Council on the group.

16.54 We also received a copy of a Memorandum of Understanding signed by the five parties identified earlier. It includes:

- an agreement to form a Governance Group comprising one councillor from both the Canterbury Regional Council, and Christchurch City Council, the Chief Executive of LPC and representatives of Ngāti Wheke and Te Runanga.
- an agreement to establish a Project Team to consult affected communities and prepare the management plan for submission to the Governance Group.
- funding commitments of $100,000 per annum for three years from CRC and LPC.

Clause 5 of the Memorandum records that it is not legally binding and may be terminated by any party on one month's notice to other parties, but during its currency parties commit to work together and in good faith.

16.55 Despite the existence of this Management Plan Ngāi Tahu sought a consent condition requiring the development of a "Mahinga Kai management and enhancement plan" to achieve a net gain in mahinga kai. We note that one of the tasks of the existing Project Team is to "Develop further objectives to describe how the ecological and cultural health (of Whakaraupō) will be restored." LPC oppose any such consent condition, but its fall-back position included provision of a draft condition in case we decided one was required. The draft included "Measures to achieve a net gain in mahinga kai are to complement the work to achieve a net gain through implementation of the Whakaraupō/Lyttelton Harbour Catchment Management

Plan….." Whether, at this point, there has been any "work to achieve a net gain" we do not know. What to our mind is significant is that LPC saw the obvious potential for the existing Plan to address the degradation of mahinga kai. This of course raises the obvious question: why have duplication of effort and resources when there is a Management Plan in existence, supported by governance and project groups?

16.56 Conclusions: We shall state our conclusions quite succinctly. We are in no doubt that dredging and spoil deposition will subject the Harbour to environmental insults on a recurrent basis. Adaptive management may be expected to alleviate the adverse effects; but nonetheless the mauri of Whakaraupō, its value as mahinga kai and Ngāi Tahu rangatiratanga will be adversely affected. These adverse cultural effects must be met by every effort on LPC's part to achieve a net gain in mahinga kai.

16.57 We can understand why Ngāi Tahu remains sceptical with regard to LPC's commitment to play an active role in restoring the health of the Harbour. There is a long history of capital and maintenance dredging in Whakaraupō. Only in the comparatively recent past has a commitment to protect and restore the marine environment been evinced. Even then, features such as the ability to opt out of the Memorandum of Understanding understandably excite some degree of distrust.

16.58 On the other hand we consider there are positive signs that a tipping point has been reached. The extent and level of the environmental safeguards proposed in the consent conditions and the EMMP is impressive. The evidence, for example of Mr John O'Dea concerning the impact of Mr Tasman Gillies evidence upon him, is reassuring. And, the public commitment of LPC to work in partnership with Ngāi Tahu to achieve a net gain in mahinga kai is significant.

16.59 At the commencement of his submissions Mr Christensen spoke about corporate environmental responsibility, a theme with which we are in complete agreement. LPC seek to benefit from Whakaraupō by expanding the channel to become big ship capable. The benefits will be appreciable not just for LPC, but for the region as a whole. But such gains come at the expense of the marine environment or at least with potential risk to that environment. We accept and share Ngāi Tahu's viewpoint that exposure to such actual or potential adverse effects requires a positive response from LPC. We consider a commitment to achieve a net gain is an appropriate response.

16.60 Should the commitment be made enforceable? This we consider is the most difficult question. Ngāi Tahu and LPC are diametrically opposed on this issue. On balance, we have concluded that imposition of a condition seeking to make LPC's public commitment enforceable is not the best way forward. We doubt whether an imposed solution will necessarily provide greater assurance as, for example, the existence of the opt-out clause in the Memorandum of Understanding tends to demonstrate. Instead LPC as a company must step up, recognise and accept its corporate responsibility to protect and promote the health of Whakaraupō in partnership with Ngāi Tahu. Dredging will continue, and so must the commitment regardless of changes in management personnel. Hence a lasting cultural shift is required. We trust LPC to honour the commitment expressed through counsel at the hearing.

16.61 Other lesser factors have also influenced us. We do not regard either of the draft conditions presented at the hearing to be satisfactory. We also consider that there is merit in Ms Appleyard's point that a negotiated partnership does not confine the parties to effects attributable to dredging alone, rather permits recovery effects in general to be assessed under the umbrella of the commitment.

16.62 For the avoidance of doubt we record:

- We contemplate that the two parties will agree that a net gain in mahinga kai is to be achieved through the Whakaraupō Management Plan structures and processes. To develop a new specific mahinga kai plan, in isolation, would make little sense.
- LPC's commitment must at least match the duration of the resource consents. Just as gains should endure for that period of time, so must the commitment. Without question, guardianship of mahinga kai values will remain essential so long as dredging insults occur.
- We anticipate and expect that, as indicated, LPC will continue negotiations with Ngāi Tahu so that a net gain becomes a key objective of the Whakaraupō Management Plan (if it is not already.) Ngāi Tahu for its part must have realistic expectations and accept that the present condition of Whakaraupō is attributable to a mix of factors. Its negotiators must also recognise that LPC operates in a competitive environment and is subject to a statutory obligation to "operate as a successful business."

17.0 Conclusions, Determination and Consent Conditions

17.1 Introduction: It remains to explain our key conclusions and indicate our decision on the application. We shall do this by reference to the four factors identified in King Salmon as determinative in deciding whether a proposed adaptive management regime is fit for purpose, applying a precautionary approach. These factors are:

a) the extent of the environmental risk,
b) the importance of the activity,
c) the degree of uncertainty, and
d) the extent to which adaptive management will diminish the risk and the uncertainty.

However, we shall not stick to this order, as the second factor can conveniently be dealt with first.

17.2 Positive effects: The importance of the proposed activity lies in the economic benefits likely to be generated through the Port's capability to service larger vessels. We accept that the need for increased capacity is pressing. And, as stated earlier, "the economic imperative is a powerful consideration" in support of the application.

17.3 Risk and Uncertainty: These factors can be considered together. The risk posed to the wide range of Harbour and near-Harbour communities has been assessed in some detail in sections 8 to 16 of our decision. Such activities range from

commercial aquaculture to recreational surfing on beaches some distance away from Whakaraupō. In essence the potential risk is similar in nature regardless of the activity. Will dredging or spoil disposal have a direct or indirect effect on one or more of these activities? It is undeniable that dredging, and perhaps to a lesser extent spoil disposal, will have a direct adverse effect on benthic communities at least in the short to medium term. Indirect effects will arise through the risk occasioned by sediment disturbance and propagation. This may include sediment accumulation on beaches, sediment settlement or "clothing" of flora or simple exposure to elevated total suspended sediment concentrations in the water column. A highly significant consideration in relation to quantifying the level of risk is that fine sediment is an ever-present natural feature of the receiving environment. Hence any risk posed to Whakaraupō, Koukourārata or Pegasus Bay is from an increase in the presence of a natural phenomenon. There is no, or very little, likelihood that the proposed activity will introduce some new environmental irritant.

17.4 This consideration is, in our view, equally relevant to assessing the degree of uncertainty. In light of the expert evidence it is fair to say that Whakaraupō in particular is a well-studied and well understood environment. We were surprised at the number of experts who knew and understood the Harbour as a result of a long-term professional involvement with it, sometimes extending to diving in the Harbour as well. In addition, dredging and spoil disposal on the northern side of the outer Harbour, has taken place for well over a century. But, dredging to lengthen, deepen and widen the navigation channel will be on a scale much in excess of anything previously experienced. This introduces a level of uncertainty that could only be assessed by resort to hydrodynamic modelling of the probable consequences.

17.5 It follows that there is both risk and uncertainty in relation to implementation of the proposal. Without question a precautionary approach must be taken in assessing the proposal, regardless whether the New Zealand or the Regional policy statement is applied. (see 4.8). Given the presence of uncertainty and the need for caution we turn to the final factor.

17.6 Is the adaptive management regime adequate? Three elements need to be considered: monitoring, hydrodynamic modelling and the M-IFD methodology. In relation to each we have already found that they meet the evidential foundation required to satisfy the threshold question in King Salmon. At this point, with effects having also been assessed, we must consider whether the regime is fit for approval given the risk, the level of uncertainty and the need for caution.

17.7 Overall, how significant is the risk and the uncertainty? First, because of the separation distance between dredging activity and sensitive communities the risk is only potential, except for the direct impact on benthic communities. A mitigating feature in relation to these communities is that they are sparse, with a low spread of species and are expected to readily recolonise post dredging and spoil disposition activity. Other harbour based communities and those outside the heads will be indirectly and less affected, assuming the hydrodynamic modelling has simulated sediment propagation with reasonable accuracy. We consider that the level of risk

may be categorised as of low to moderate probability with, at worst, a similar potential environmental impact.

17.8 Two aspects influence the level of uncertainty; the much increased scale of the proposal in relation to both dredging and deposition and the need to assess the likely predictive accuracy of the modelling. With regard to the modelling we see the dominance of tidal flows on the shape and extend of plumes, coupled with the conservative approach taken by Dr Beamsley in fixing various parameters he adopted, as important factors. Again, we consider the level of uncertainty should be characterised as low to moderate.

17.9 Finally then, does the proposed management regime provide assurance that dredging in particular will be managed so that environmental effects are avoided or mitigated? We consider the proposed monitoring system is comprehensive indeed. We are also satisfied that the trigger values and management intervention requirements will prove to be robust. The essence of the regime is that it stipulates intervention (ultimately a cessation of dredging), when total suspended sediment levels at sentinel monitoring sites reach identified percentiles of turbidity (not the extremes), measured in relation to both intensity and time (duration). This impresses us as a precautionary approach. In addition the regime includes extensive reporting, independent oversight, review, and amendment requirements[30]. These will ensure that experience gained, particularly over the first dredging campaign, is utilised to refine and improve the management protocols. Hence we are satisfied that the regime will adequately diminish the level of risk and uncertainty that presently exists. In short, we find that the regime is fit for purpose.

17.10 Consent Conditions: There are separate sets of conditions for channel deepening and maintenance dredging. However, these are substantially similar. The maintenance dredging conditions do not include a marine mammal management plan, a peer review group (PRG) section, or an accidental discovery protocol. Although the conditions are referred to in various parts of this decision, an overview of their content has not been provided. We consider this is necessary for a proper understanding of the adaptive management regime. This brief overview is of the channel deepening conditions.

17.11 The coverage of the two consents, being a Coastal Permit and a Discharge Permit are described first, followed by the duration period sought (35 years), and a Definitions section. Then the conditions are set out in thirteen appropriately entitled sections:

1. Location, Volume and Staging

   Six conditions identify where dredging and spoil deposition is to occur (by reference to attached plans), state the maximum volume of material that may be dredged (18 million m^3), stipulate how spoil is to be evenly distributed, and

[30] These requirements are contained in the proposed conditions. Their extent and coverage is evident from the overview of conditions in paragraph 17.11

provide that if the maximum volume is to be dredged there must be at least two dredging campaigns.

2. Administration

Two conditions empower the CRC to review and amend the conditions as necessary (including the monitoring programme, the turbidity triggers and management response measures); and the second sets a lapse date (10 years after commencement of the consent).

3. Notification and Records

Two conditions require LPC to provide a dredging programme (before dredging commences) and for the CRC to maintain a record (of when, where and the volume of spoil dredged; and likewise of its disposal.)

4. Dredge Management Plan (DMP)

Seven conditions require the advance preparation of a DMP to specify how adverse effects will be avoided or mitigated: which must cover ten areas (dredge type, dredging methods, records, maintenance, bird strike avoidance, employee training etc); to be prepared by a qualified person, and provided to the CRC (and certified by it), and to Tangata Whenua, the TAG and the ALG.

5. Marine Mammal Management Plan (MMMP)

Four conditions specify the provision of a MMMP that covers avoidance of vessel strikes and noise impacts; by utilisation of a designated observer, speed guidelines, use of DOC sighting information and noise minimisation measures; such plan to be prepared by an expert, certified by CRC and provided to Tangata Whenua and the TAG.

6. Biosecurity Management Plan (BMP)

Seven conditions: require the preparation of a BMP to manage biosecurity incursion including from the dredge vessel and to marine farms; specify the plan content (dredge protection, risk sources, mitigation measures, treatment measures, inspection details and record keeping); and provide for certification and distribution of the plan (to Tangata Whenua, the TAG and the ALG).

7. Environmental Monitoring and Management Plan (EMMP)

This is the key Plan for implementation of adaptive management. Seventeen conditions require the preparation and advance provision of the EMMP (to CRC, Tangata Whenua, the TAG and the ALG) and for a written review of the Plan within a year of completion of the first dredging campaign. The EMMP must address: monitoring of plumes, exceedances, management actions in response to exceedances, assurance monitoring, reporting requirements, roles of watch-dog groups, management plan needs, and complaint procedures. Particular requirements relating to monitoring of turbidity, management

responses, and assurance monitoring are prescribed; as is certification of the Plan and its distribution to Tangata Whenua, the TAG and the ALG.

8. Monitoring

Twenty conditions govern: baseline, dredging and assurance monitoring; including prescription as to the minimum number of monitoring stations; instrumentation zones (channel, inshore spoil ground, and offshore); communities to be monitored (benthic, sub-tidal, inter-tidal and beach); frequency and duration of monitoring; and reporting requirements (before, during and after dredging.)

9. Turbidity Triggers

Nine conditions specify how trigger levels are to be established for each monitoring location, require LPC to provide an expert report to verify level establishment; and define compliance requirements in response to a tier three exceedance (relocation, cessation of dredging and the "extraordinary natural event" proviso).

10. Consent Holder Project Team (CHPT)

Two conditions prescribe that LPC must retain personnel to manage the project and ensure compliance with the conditions; and define the expertise required by such personnel.

11. Technical Advisory Group (TAG)

Nine conditions define the membership and expertise (12 persons from Tangata Whenua, marine farming and LPC), functions of, and administrative arrangements for, the TAG[31].

12. Aquaculture Liaison Group (ALG)

Ten conditions provide for the establishment of the ALG to liaise with LPC in relation to monitoring information and adverse effects on marine farming at meetings of farming and LPC representatives (up to three) from each; and also describe administrative arrangements for such meetings.[32]

13. Peer Review Group (PRG)

Eight conditions require the formation of the PRG comprising three scientists (experts in marine ecology, coastal processes and hydrodynamic modelling) to review and report on the EMMP (whether it is compliant with the conditions or requires amendment); and to advise whether baseline, quarterly and dredging

[31] A TAG was established to provide advice in relation to establishing the adaptive management regime and as actively engaged in that role. The TAG described above will advise in relation to implementation of the project.

[32] The ALG concept arose from discussions after marine farmers filed submissions in opposition to LPC's application. The Group's formation is the key element of a negotiated settlement of differences.

monitoring reports, and exceedance reports, are compliant, and whether consent conditions are appropriate or require amendment.

14. Website Obligations

Two conditions require LPC to maintain a public website that displays a real-time data summary, monitoring reports, exceedance reports, plan amendments, and TAG or PRG reports/reviews.

15. Complaints

Three conditions require LPC to: record dredging-related complaints (including the cause of the complaint and any action taken) and periodically advise CRC and the TAG of the complaints received.

16. Accidental Discovery Protocol

Four conditions prescribe LPC's obligations should archaeological material be discovered during dredging, namely to cease dredging, and advise the CRC and Heritage New Zealand, and follow directions.

17.12 In our view it is difficult to imagine a more comprehensive set of conditions. Not only are the adaptive management requirements prescribed in detail, there are checks and balances overseen by the CRC and other independent groups, and ample scope to review and amend processes in light of experience. This provides assurance that the management regime is adaptive, and precautionary as well.

17.13 Determination

By a considerable margin we are satisfied that the coastal and discharge permits sought by LPC should be granted. We are also satisfied that the consent conditions are satisfactory as they stand subject to the requirements and discussion below. We note that revised conditions responding to submitters concerns were tabled on the final hearing day[33]. We considered these and subsequently issued two minutes[34] requesting clarification of various matters of concern. Hence the final iteration of the conditions[35] incorporates changes in response to our minutes. LPC's consultative approach to framing the conditions, which were regularly refined by Mr Andrew Purves in response to submissions, is reflected in the limited number of matters we need to discuss below.

17.14 Conditions 8.19 - 8.20: These two conditions specify actions to be taken when a subsequent dredging phase is about to occur and seven years have elapsed since the previous stage. The CHPT must consult the TAG and the ALG and prepare:

a. a report that evaluates whether further baseline monitoring is required, and

b. if so, a programme of further monitoring.

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[33] 12 May 2017

[34] Sixth and Seventh Minutes of the Commissioners, 19 May and 31 May, respectively

[35] Provided on 2 June

Condition 8.20 provides that if the CRC disagrees with the report finding it may:

a. detail its reasons for such disagreement, and
b. specify an alternative baseline monitoring period (not to exceed 12 months).

17.15 The Council Officers in their 9 May addendum to the s42A report recommended that the PRG should be involved, and it should "provide a recommendation report and the decision lie with the Consent Authority…"

17.16 We accept that these conditions require attention. The previous iteration of the conditions specified a gap of 5 years between dredging phases and included a procedural requirement under then 8.20 that the CHPT report be provided to the Consent Authority in time to accommodate further monitoring before commencement of the next dredging phase, but this requirement is omitted from the final iteration (we assume this is an oversight.). No justification for the change to a 7 year gap has been provided, and we consider 5 years was, and remains, appropriate. We agree that it should be the Consent Authority that decides if further monitoring is required and if so the period thereof. This condition as drafted contemplates disagreement concerning the duration of the further monitoring period, but not as to the need for monitoring which is the more substantial issue. This is not logical (and may be a drafting error, rather than an intended omission.) Thirdly, should the PRG be involved and provide a "recommendation report" to the CRC? We agree that this is appropriate. The present functions of the PRG are to provide written advice to the Consent Authority concerning:

a. whether it should certify the EMMP,

b. whether, after a dredging phase, any conditions require review, and

c. whether monitoring reports comply with the EMMP and the consent conditions.

Hence, provision of written advice on further baseline monitoring is in keeping with the PRG's function. Moreover, monitoring is a matter within the expertise of its members and after a delay of five years it is also an issue of some consequence. We consider that the CHPT should report directly to the PRG (without consultation of the TAG or the ALG) and the PRG shall provide written advice to the Consent Authority concerning both the need for, and duration of, monitoring.

17.17 Conditions 7.7 to 7.10: The Council Officers supported evidence of Ms Philippa Lynch, a Ngāi Tahu witness, that management responses to turbidity trigger exceedances should be more stringent. In particular the officers consider that if two tier 2 or 3 exceedances occur within a rolling allowable duration period then additional response measures should be prescribed in the EMMP including "sediment transport modelling which considers the meteorological and oceanographic conditions at the times of exceedance." The EMMP presently prescribes that following a tier 2 exceedance the CHPT shall:

- notify the TAG and PRG of the event
- ensure the dredging operator increases management measures (as defined for tier 1.)

- review monitoring and environmental data which may have caused a natural increase in turbidity.
- Undertake additional monitoring in the exceedance area, if deemed necessary.

Following a tier 3 exceedance there must be immediate notification to the CRC, PRG, TAG and the ALG; and dredging and/or spoil disposal must cease while the turbidity level remains non-compliant. In addition, there must be an investigation and report prepared if natural causes are to be blamed for the occurrence and, after full investigation, an exceedance report provided to the CRC, PRG and the TAG, in all cases.

17.18 We are not persuaded that additional management measures are required in relation to tier 2 or 3 exceedances. An ultimate tier 3 exceedance necessitates a major response as described above. Should there be multiple exceedances, which seems to be the cause for concern, we anticipate that the Council would review the consent conditions pursuant to condition 2.1. A review may include amendment of: the turbidity triggers, management response requirements or the monitoring programmes. Similarly, we consider that the heightened gradation of response for a tier 2 exceedance is adequate when viewed in the context of the conditions as a whole.

17.19 Condition 1 – Maintenance Dredging Conditions: The Officers also raised concern that condition 1.4 did not specify the maximum volume of spoil that may be deposited at the Godley Head ground (because the annual amount had not been quantified). The omission was rectified in the final iteration of these conditions, so this concern is resolved given that the volume specified is reasonable.

17.20 Term of the Consent – 35 years: The Officers suggested that a reduction in the term of the channel deepening consent may be appropriate. They noted that Ngāi Tahu sought this to provide increased certainty, and also that Mr O'Dea's evidence was that LPCs intention was to "catch up" by commencing the first dredging campaign within three years. This indicated a very long period, say almost 30 years, before a second campaign need be commenced.

17.21 For two reasons we do not accept this recommendation. Firstly, adoption of the 35 year statutory maximum[36] provides certainty. Anyone can calculate when the consent will expire. A reduction will not increase certainty. Secondly, and more importantly, we consider that LPC has established a basis for fixing the duration at 35 years. The intention is to complete stage one promptly and achieve big ship capacity, but dependent on tide conditions. When the Port will need to be fully big ship capable will depend on future trends and developments. Forecasting these is difficult. Flexibility should be provided, and 35 years will achieve that.

17.22 Retention of the Godley Head Spoil Ground: LPC has an existing resource consent CRC135317 to discharge contaminants to the coastal marine area. The consent was

[36] RMA s123 (c)

granted on 3 April 2014, with a 3 April 2049 expiry date. It authorises spoil dumping along the northern coastline of the Harbour (from Gollans Bay to Godley Head), subject to a wide range of conditions including: five-yearly monitoring, pre-characterisation of Inner Harbour sediments, additional monitoring (if trigger levels from chemical analysis of samples are exceeded) and requirements to prepare various management plans. There is no limit upon the annual volume of spoil deposited.

17.23 In large measure, the proposed maintenance dredging conditions displace the ambit of CRC135318. Firstly, condition 1.1 (and the attached plan) provide that the full extent of the new wider and longer (extended) channel falls under the proposed consent; meaning that only dredging within the Inner Harbour will remain under the existing consent. Secondly, proposed condition provides:

> 1.2 The discharge (dumping) of Dredge Spoil shall occur within the area of the offshore maintenance disposal ground or the Godley Head maintenance disposal ground marked on Plan CRC172456A.
> 1.3 The Godley Head maintenance disposal ground shall only receive Dredge Spoil in the following circumstances:
> 1.3.1 The offshore maintenance disposal ground cannot be used due to rough sea-state conditions; or
> 1.3.2 The vessel used to transport Dredge Spoil is insufficiently sea worthy to dispose of sediment outside the head.
> 1.4 Notwithstanding condition 1.3, the maximum amount of Dredge Spoil disposed of at the Godley Head maintenance disposal ground, measured in tons, shall not exceed 167,000 tons per annum

17.24 Plan CRC172455A depicts the Godley Head spoil ground (an area of about 100ha), while an advice note indicates that 167,000 -tons of spoil "is equivalent to a 100,000 cubic metre (of) in-situ volume…" Condition 1.3 caters for two scenarios: when sea conditions prevent even a larger maintenance dredger from using the offshore ground and when the vessel towing the barge servicing the backhoe dredger cannot venture offshore.

17.25 A number of individual and corporate submitters, and Ngāi Tahu, contended that the use of Godley Head should be prohibited, and the offshore ground should receive all maintenance spoil. We do not accept this contention for the following reasons:

- the existing consent CRC135318 continues to cover spoil from the Inner Harbour and authorises its disposal at the inshore ground
- nonetheless, LPC has gone a considerable distance by accepting that Godley Head should only be used as a back-up when sea conditions or vessel limitations prevent disposal offshore
- in addition, condition 1.4 limits the deposition volume to 167,000 tons per annum
- there is an incentive to use the offshore ground whenever possible, in that modelling predicts that spoil deposited at Godley Head may be susceptible to recirculation back into the navigation channel

- other than suspending dredging there is no alternative to using Godley Head when adverse sea-conditions prevail
- there is no evidence that the historic level of disposal along the northern coastline has had more than a minor ecological effect.

17.26 In combination these factors compel us to the view that the proposed conditions strike the correct balance. Should the use of Godley Head as a backup site bring about some unforeseen adverse effect, the review provision (condition 2.1) could be utilised by the Council to address the matter.

17.27 Summary of Determinations. To summarise we have determined:

a. the four resource consents are **granted** pursuant to s104B of the Resource Management Act 1991, namely **CRC172455** – a Coastal Permit, **CRC172522** – a Discharge Permit; **CRC172456** – a Coastal Permit and **CRC172523** – a Discharge Permit,

b. subject to the conditions attached to this decision and imposed pursuant to section 108 (which include amendments to the Channel Deepening conditions 8.19 - 8.20 as detailed at paragraph 17.16), and

c. that the mauri of Whakaraupō, its value as mahinga kai and Ngāi Tahu rangatiratanga will be adversely affected by recurrent dredging and spoil deposition, and these adverse cultural effects must be met by every effort on LPC's part to achieve a net gain in mahinga kai in partnership with Ngāi Tahu through the Whakaraupō/Lyttelton Harbour Catchment Management Plan

Decision Dated 12 July 2017

Sir Graham Panckhurst

Peter Atkinson

Raewyn Solomon

CRC172455 – A Coastal Permit under section 12 of the Resource Management Act 1991:

1: To dredge (disturb) seabed material for the purposes of deepening, extending and widening a shipping (navigation) channel that includes a ship-turning basin, and berth pockets;

2: To dredge (disturb) seabed material for the purposes of the construction of a reclamation in Te Awaparahi Bay; and

3: To deposit seabed material on the seabed associated with 1 and 2 above.

CRC172522 – A Discharge Permit under sections 15, 15A and 15B of the Resource Management Act 1991:

1: To discharge contaminants (seabed material and water) into water associated with channel deepening dredging as described in CRC172455

2: To discharge (dump) dredge material from a ship into water at the disposal ground as described in CRC172455; and

3: To discharge contaminants (seabed material and water) from a ship into water associated with channel deepening as described in CRC172455.

TERM OF CONSENT

The duration of consent shall be 35 years.

General Advice Note on Conditions

1 The conditions below apply to both CRC172455 and CRC172522
2 The Plans attached to and forming part of this consent apply to CRC172455 and to CRC172522

CONDITIONS OF CONSENT –

DEFINITIONS

For the purposes of this consent conditions the following definitions shall apply:

"**ADCP**" means an acoustic doppler current profiler;

"**ALG**" means the Aquaculture Liaison Group;

"**Allowable Duration**" is the maximum number of hours in a rolling 30 day period during which the Intensity prescribed at a telemetered turbidity monitoring location in relation to turbidity trigger Tiers 1, 2 or 3 may be exceeded without a management action being required. The maximum number of hours for each Tier is as follows:

Tier 1: 144

Tier 2: 36

Tier 3: 7.2;

"**Authorised Marine Farm**" means any marine farm that, as at the date this consent is first exercised, exists or which holds an existing but unimplemented resource consent. Authorised marine farming activity has the same meaning.

"**Authorised Marine Farmer**" means any person who operates an Authorised Marine Farm;

"**BMP**" means the Biosecurity Management Plan;

"**Certification**" means that the DMP, BMP, MMMP and EMMP meets all the requirements set out in the conditions of the relevant resource consent(s);

"**CHPT**" means the Consent Holder Project Team;

"**Consent Authority**" means the Canterbury Regional Council or any successor;

"**Consent Authority Manager**" means the Canterbury Regional Council, Attention: Regional Leader, Monitoring and Compliance;

"**CRMS**" means Craft Risk Management Standard;

"**DMP**" means the Dredge Management Plan;

"**Dredge Spoil**" means seabed material that has been removed by a dredge and is to be disposed of at the designated spoil disposal ground;

"**Dredging**" means dredging and disposal activities;

"**Dredging Stage**" means the period when a dredge is deployed at Lyttelton for channel deepening and deepening for reclamation (identified on Plan CRC172455A) to a specified design depth for that stage.

"**EMMP**" means the Environmental Monitoring and Management Plan; "**Exceedance**" means the exceedance of an Allowable Duration;

"**IHS**" means Import Health Standard;

"**Intensity**" means the turbidity level (in NTU) established for each Tier at each telemetered turbidity monitoring location using the methodology contained in Appendix 2 and the following percentiles:

Tier 1: 80%

Tier 2: 95%

Tier 3: 99%;

"**MMMP**" means the Marine Mammal Management Plan;

"**Navigation Channel**" means the navigation channel, ship turning basin, and berthage areas;

"**Northern Banks Peninsula**" (in the context of marine farms) means those marine farms that are authorised at the date of the first exercise of this consent and are located to the west of a line between Motunau and Steep Head;

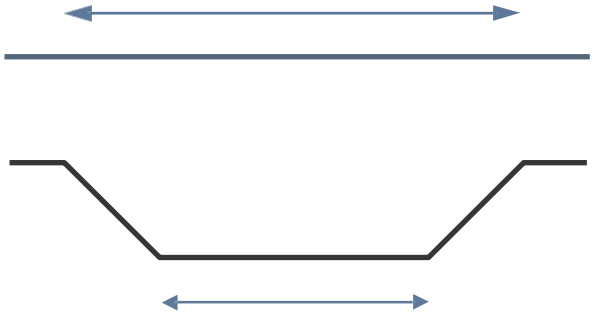
"**NTU**" means nephelometric turbidity unit;

"**Predicted Dredging Turbidity**" means the TSS from the Dredging that is predicted from the hydrodynamic modelling detailed in Appendices 9 and 10A and 10B of the Assessment of Environmental Effects supporting the application lodged on 28 September 2016;

"**PRG**" means the Peer Review Group;

"**Shipping Channel**" means the Navigation Channel (see diagram below) and all associated batter slopes;

Shipping channel width (including batter slope)



Navigation channel width

(Cut view of channel)

"**TAG**" means the Technical Advisory Group;

"**Tangata Whenua**" means Te Hapu o Ngati Wheke (Rapaki), Te Runanga o Koukourarata and Te Runanga o Ngai Tahu;

"**TSS**" means Total Suspended Solids.

1. LOCATION, VOLUME AND STAGING

1.1 Dredging operations shall occur within the Shipping Channel in order to create the Navigation Channel marked on Plan CRC172455A attached to and forming part of this consent.

1.2 Dredging operations shall occur within the area subject to future reclamation marked on Plan CRC172455A.

1.3 The discharge (dumping) of Dredge Spoil shall occur within the channel deepening disposal ground marked on Plan CRC172455A.

1.4 The maximum volume of seabed material discharged (dumped) by the dredge vessel at the channel deepening disposal ground shall not exceed 18 million cubic metres of in situ sediment.

1.5 Dredge Spoil shall, to the extent practicable, be distributed evenly across the channel deepening disposal ground. A Global Geographical Positioning System (GPS) shall be used on the vessel to plot the location of each spoil release within the channel deepening disposal ground. The plots shall be graphically presented with the channel deepening disposal ground boundary shown for reference and shall be attached to the monthly monitoring reports required under condition 8.15.

1.6 If Dredging is to provide for a 14.5m draught vessel to enter Lyttelton Port across all tides, which involves removing approximately 18 million cubic metres of in situ sediment, then the Dredging shall be completed in no fewer than two Dredging Stages.

2. **ADMINISTRATION**

2.1 The Consent Authority may, on the last working day of each month, serve notice of its intention to review the conditions of this consent for the purposes of:

2.1.1 Dealing with any adverse effect on the environment which may arise from the exercise of this consent;

2.1.2 Amending the monitoring programmes required by this consent, including adding or deleting monitoring site locations and adding or deleting specific monitoring parameters;

2.1.3 Amending the real-time turbidity monitoring, turbidity triggers and the management response measures after a Dredging Stage should the assurance monitoring reveal an unforeseen effect that is attributable to Dredging; and

2.1.4 Requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.

2.2 The lapsing date for the purpose of section 125 shall be 10 years after the commencement of the consent.

3. **NOTIFICATION AND RECORDS**

3.1 Prior to a Dredging Stage, the consent holder shall provide a programme of intended Dredging, including the timing of the Dredging Stage and the areas and depth of

proposed Dredging. The programme shall be submitted to the Consent Authority Manager not less than one month prior to the commencement of the Dredging Stage.

3.2 The consent holder shall keep records detailing the timing, quantities and location of seabed material dredged, and also of the Dredge Spoil disposed of within the channel deepening disposal ground. These records shall be submitted to the Consent Authority Manager within one month of cessation of a Dredging Stage or at any time upon request from the Consent Authority.

4. **DREDGE MANAGEMENT PLAN (DMP)**

4.1 At least two months prior to the commencement of the first Dredging Stage, the consent holder shall provide to the Consent Authority Manager a DMP. A copy of the DMP shall be provided to the Tangata Whenua, the TAG and the ALG at the same time as it is provided to the Consent Authority.

4.2 The purpose of the DMP shall be to specify how Dredging practices and procedures will ensure that any actual or potential adverse effects on the marine receiving environment are avoided or otherwise mitigated to the greatest extent practicable.

4.3 The DMP shall include, but not be limited to, the following:

4.3.1 A description of the number and types of dredges to be used;

4.3.2 A description of Dredging methodology typically used;

4.3.3 A description of how the location and quantities of Dredge Spoil are recorded;

4.3.4 A description of the maintenance of equipment and systems;

4.3.5 A description of the storage and handling of hazardous substances;

4.3.6 A description of the outdoor lighting being used in order to reduce the potential for bird strike such as the targeting of luminaries and the use of shields or baffles;

4.3.7 A description of measures to manage any conflicts between the Dredging program and organised sporting events in Lyttelton Harbour;

4.3.8 A description of a turbulence reducing (green or environmental) valve to be incorporated with the overflow system;

4.3.9 Details of the training for a person involved in the operation of the dredge so that he/she may recognise any potential archaeological material including koiwi tangata or taonga; and

4.3.10 A description of all other necessary measures to avoid or mitigate adverse effects on the receiving environment to the greatest extent practicable during the operation of the dredge vessel; including measures relating to biofouling, management of waste, and refuelling.

4.4 A suitably qualified and experienced person in operating a dredge shall review and be involved in the preparation of the DMP.

Certification of DMP

4.5 The DMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved DMP.

4.6 Any amendment of the DMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended DMP.

4.7 A copy of the DMP and all amended DMPs shall be provided to Tangata Whenua, the TAG and the ALG immediately following Certification.

5. **MARINE MAMMAL MANAGEMENT PLAN (MMMP)**

5.1 At least two months prior to the commencement of the first Dredging Stage, the consent holder shall provide a MMMP to the Consent Authority. A copy of the MMMP shall be provided to Tangata Whenua and the TAG at the same time as it is provided to the Consent Authority.

5.2 The purpose of the MMMP shall be to specify how the risk of vessel collision and the risk of impacts from dredge noise on marine mammals are to be is reduced to the greatest extent practicable.

5.3 The MMMP shall include, but not be limited to, the following:

5.3.1 A requirement for a regular crew member on the dredge to be a designated marine mammal observer, whose role includes record keeping;

5.3.2 Details of the training to be provided to the designated observer, which is to be delivered by a suitably qualified marine mammal expert;

5.3.3 Detailed guidelines for the vessel, including speed limits, to reduce any chances of mortality from vessel strikes with whales, particularly the southern right whales;

5.3.4 The information protocols concluded with the Department of Conservation to help anticipate any potential seasonal interactions with any whale species sighted;

5.3.5 Description of the methods to characterise underwater noise produced during the operation of the dredge vessel to determine whether there is a potential for a temporary threshold shift in hearing to occur in marine mammals and any measures to reduce this potential effect; and

5.3.6 Description of the measures to maintain the vessel, including all dredging equipment, to reduce underwater noise.

5.4 The MMMP shall be prepared by a suitably qualified person who is experienced in managing potential effects on marine mammals and in the measurement and assessment of underwater noise in the marine receiving environment.

Certification of MMMP

5.5 The MMMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved MMMP.

5.6 Any amendment of the MMMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended MMMP.

5.7 A copy of the MMMP and all amended MMMPs shall be provided to Tangata Whenua and the TAG immediately following Certification.

6. **BIOSECURITY MANAGEMENT PLAN (BMP)**

6.1 At least one month prior to the arrival of the dredge vessel in New Zealand, the consent holder shall provide a BMP to the Consent Authority. A copy of the BMP shall be provided to Tangata Whenua, the TAG and the ALG at the same time.

6.2 The purpose of the BMP shall be to specify how the risk of a biosecurity incursion is to be reduced to the greatest extent practicable.

6.3 The BMP shall include, but not be limited to, the following:

6.3.1 A description of the dredge vessel and its attributes that affect risk, including key operational attributes (e.g. voyage speed, periods of time idle), maintenance history (including prior inspection and cleaning undertaken), and

voyage history since last dry-docking and antifouling (e.g. countries visited and duration of stay);

6.3.2 A description of the key sources of potential marine biosecurity risk from ballast water, sediments and biofouling. This should cover the hull, niche areas, and associated equipment, and consider both submerged and above-water surfaces;

6.3.3 An assessment of the biosecurity risks to Authorised Marine Farming activities from activities authorised by this consent and the methods to be used to minimise those risks to the greatest extent practicable;

6.3.4 Findings from any previous inspections;

6.3.5 A description of the risk mitigation taken prior to arrival in New Zealand, including but not limited to:

6.3.5.1 Routine preventative treatment measures and their efficacy, including the age and condition of the antifouling coating, and marine growth prevention systems for sea chests and internal sea water systems;

6.3.5.2 Specific treatments for submerged and above-water surfaces that will be undertaken to address IHS and CRMS requirements prior to departure for New Zealand. These could include, for example, in-water removal of biofouling, or above-water cleaning to remove sediment;

6.3.5.3 Additional risk mitigation planned during transit to New Zealand, including expected procedures for ballast water management; and

6.3.5.4 Expected desiccation period of above-water surfaces on arrival to New Zealand (i.e. period of air exposure since last dredging operations);

6.3.6 The nature and extent of pre-border inspection that will be undertaken (e.g. at the overseas port of departure) to verify compliance with IHS and CRMS requirements; and

6.3.7 Record keeping and documentation of all mitigation undertaken (i.e. prior to and during transit to New Zealand) to enable border verification if requested by Ministry for Primary Industries or its successor, and to facilitate final clearance.

6.4 The BMP shall be prepared by a suitably qualified person who is experienced in managing the risk of biosecurity incursions and who shall be appointed by the consent holder following consultation with the ALG.

Certification of BMP

6.5 The BMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved BMP.

6.6 Any amendment of the BMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended BMP.

6.7 A copy of the BMP and all amended BMPs shall be provided to Tangata Whenua, the TAG and the ALG immediately following certification.

7. **ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN (EMMP)**

7.1 At least two months prior to the commencement of the first Dredging Stage, the consent holder shall provide an EMMP to the Consent Authority. A copy of the EMMP shall be provided to Tangata Whenua, the TAG and the ALG at the same time as it is provided to the Consent Authority.

7.2 Within one year after the first Dredging Stage has been completed the CHPT shall complete a formal written review of the EMMP in consultation with the TAG. The review shall examine the implementation of the EMMP during Dredging, any potential gaps in the EMMP and otherwise confirm that the EMMP is in compliance with the conditions of this consent. A copy of the written review shall be provided to the Consent Authority.

7.3 The purpose of the EMMP is to detail how:

7.3.1 Turbidity monitoring and adaptive management actions are implemented to minimise the risk of elevated turbidity that can be attributed to Dredging and causing adverse effects on sensitive receptors, including Authorised Marine Farms;

7.3.2 Assurance monitoring is implemented to evaluate any actual or potential biological and physical effects and compare them with:

7.3.2.1 Those predicted effects in the information filed in support of the application; and

7.3.2.2 The assurance monitoring data collected during baseline monitoring required under condition 8.3.

7.4 The EMMP shall at a minimum address the following topics:

7.4.1 The monitoring of turbidity plumes;

7.4.2 Adaptive management actions to be undertaken in response to an exceedance of a turbidity trigger;

7.4.3 Assurance monitoring, including in respect of Authorised Marine Farms;

7.4.4 Reporting requirements;

7.4.5 Roles and responsibilities of groups involved in monitoring and any adaptive management actions;

7.4.6 Identifying any other relevant management plans; and

7.4.7 Documenting procedures for handling complaints.

Monitoring of Turbidity

7.5 As part of an EMMP, the consent holder shall detail how the turbidity plumes are to be monitored to:

7.5.1 Confirm whether or not turbidity plumes exceed the turbidity triggers that are to be specified under condition 7.8; and

7.5.2 Assess the relative contributions of Dredging and non- Dredging sources to observed turbidity.

7.6 The EMMP shall include, but not be limited to, the following details:

7.6.1 The monitoring equipment to be used, including the use of nephelometers and ADCPs;

7.6.2 The location of the monitoring equipment;

7.6.3 The setting up and maintenance of monitoring equipment;

7.6.4 The establishment of real-time monitoring that can be made readily accessible to the TAG and PRG through reporting or notification emails, and a summary of how real-time turbidity monitoring is to be readily accessible on the web for the community generally; and

7.6.5 Data management.

Adaptive Management Actions in Response to Turbidity Plumes

7.7 As part of an EMMP, the consent holder shall detail the adaptive management actions to be carried out in response to elevated turbidity as defined by the turbidity triggers.

7.8 To achieve condition 7.7, the EMMP shall include, but not be limited to, the following:

7.8.1 Details of the rationale for classifying the turbidity observations into three tiers of turbidity triggers;

7.8.2 Details of how the Tier 1, Tier 2 and Tier 3 turbidity triggers are determined using the methodology referred to in condition 9.2..

7.8.3 Setting out the Intensity values for Tier 1, Tier 2 and Tier 3 turbidity triggers which are based on the 80th, 95th, and 99th percentile of baseline plus Predicted Dredge Turbidity respectively.

7.8.4 Description of the adaptive management actions set out in condition 7.10 and how they may be applied by the dredge operator when a Tier 1, Tier 2 or Tier 3 turbidity trigger is exceeded, and a description of the compliance requirements for a Tier 3 exceedance as specified under condition 9.10.

7.9 The EMMP shall include procedures on:

7.9.1 Notifying the TAG and ALG, and where relevant notifying the PRG, of an exceedance;

7.9.2 Investigating whether the exceedance of the trigger is caused by Dredging; and

7.9.3 Increasing monitoring effort where necessary;

7.10 The EMMP shall also include a suite of management response measures where the exceedance of a trigger has been attributed to Dredging, including, but not limited to:

7.10.1 A change of the disposal location within the channel deepening disposal grounds;

7.10.2 A change in the location of Dredging;

7.10.3 A change in the Dredging process, including timing of Dredging within the tidal phase;

7.10.4 The possible cessation of Dredging at a location until the operator determines that the conditions are appropriate for re- commencement at the location.

Assurance Monitoring

7.11 The EMMP shall detail the methods to monitor the marine receiving environment:

7.11.1 Before Dredging operations commence so that a baseline of information is established against which subsequent changes can be referenced; and

7.11.2 During and after Dredging to evaluate how ecology and the physical environment are responding to Dredging, and confirm that Dredging-related suspended solids are not adversely affecting Authorised Marine Farms and other sensitive receptors.

7.12 The EMMP shall include, but not be limited to, the following:

7.12.1 Sub-tidal, intertidal and benthic ecological surveys which are to carried out prior to, during and after Dredging activities;

7.12.2 Water quality monitoring which is to carried out before, during and after Dredging;

7.12.3 Sediment and Dredge Spoil quality monitoring;

7.12.4 Physical beach shore monitoring;

7.12.5 Bathymetric surveys; and

7.12.6 Inspections of marine farms, where necessary.

Reporting Requirements

7.13 As part of the EMMP, the consent holder shall detail the reporting requirements specified in the conditions of consent and otherwise needed to achieve the purpose of the EMMP.

Other Management Plans

7.14 As part of the EMMP, the consent holder shall list the other Plans prepared under this consent.

Certification of EMMP

7.15 The EMMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved EMMP.

7.16 Any amendment of the EMMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended EMMP.

7.17 A copy of the EMMP and all amended EMMPs shall be provided to Tangata Whenua, the TAG and the ALG immediately following Certification.

8. MONITORING

8.1 The consent holder shall undertake a monitoring and reporting programme in accordance with conditions 8.2 to 8.21.

8.2 The purpose of the monitoring programme is to:

8.2.1 Provide baseline information sufficient to enable the effects of Dredging to be determined;

8.2.2 Monitor during Dredging so that any adaptive management actions can be carried out in a timely manner;

8.2.3 Monitor during and after each Dredging Stage to evaluate the effects and compare them with those predicted in the information filed in support of the application, and also compare them with the baseline monitoring data.

8.3 The consent holder shall carry out baseline monitoring over a period of at least one year prior to the first commencement of Dredging authorised by this consent;

8.4 There shall be no fewer than 14 stations monitoring water quality with not less than 13 stations carrying out telemetered monitoring of turbidity (NTU) for the purposes of adaptive management and one station being used as a reference site.

8.5 The water quality stations shall be located in the Instrumentation Zones shown on Plan CRC172455B attached to and forming part of this consent as follows:

8.5.1 There shall be no fewer than six stations within the channel zone;

8.5.2 There shall be no fewer than three stations within the inshore zone, one purpose of which is to provide representative water quality data for the areas where Authorised Marine Farms occur;

8.5.3 There shall be no fewer than three stations within the Spoil Ground zone; and

8.5.4 There shall be no fewer than two stations within the offshore zone.

8.6 There shall be no fewer than 14 ecological stations monitoring the benthic communities during Dredging and there shall be at least a further five benthic stations (giving a total of at least 19) used to monitor the benthic communities during the baseline monitoring period and after a Dredging Stage, as shown on Plan CRC172455C attached to and forming part of this consent.

8.7 There shall be no fewer than six ecological stations monitoring sub-tidal communities as shown on Plan CRC172455C.

8.8 There shall be no fewer than four ecological stations monitoring intertidal communities as shown on Plan CRC172455C.

8.9 There shall be no fewer than 15 physical beach shore stations as shown on Plan CRC172455D and forming part of this consent and there shall be no fewer than ten bathymetric transect lines as shown on Plan CRC172455E and forming part of this consent.

8.10 There shall be no fewer than four instruments measuring the acoustics from marine mammals shown on Plan CRC172455F and forming part of this consent.

8.11 The consent holder shall monitor for, but not be limited to, the parameters listed in the table contained in **Appendix 1**. Each parameter shall be monitored at the frequency and duration set out in the table. The specific location of the water quality monitoring stations, the parameters to be monitored at each station, and the methodology and equipment to be used are to be detailed in the EMMP. The methodology and equipment to be used at the other monitoring stations is to be detailed in the EMMP.

8.12 The monitoring programme contained in the EMMP shall be designed and carried out by a person(s) who is suitably experienced in the monitoring of the marine environment.

Reporting

8.13 The CHPT shall prepare a baseline monitoring report. The report shall:

8.13.1 Present and discuss the results of baseline monitoring; and

8.13.2 Recommend any amendments to the EMMP to change the location of a station(s) within the relevant zone or the monitoring parameters at each station, provided that the amended locations or monitoring parameters at the station better achieve the purpose of the EMMP.

8.14 The baseline monitoring report shall be provided to the TAG, PRG, ALG and the Consent Authority at least two months prior to the first commencement of Dredging.

8.15 During and after a Dredging Stage, the CHPT shall provide to the TAG and ALG, no later than by the end of the third working week of the month, a monthly report that summarises the water quality monitoring data from the previous month and any monitoring or equipment issues that occurred during that period.

8.16 During and after a Dredging Stage, the CHPT shall provide to the TAG, PRG, ALG and the Consent Authority no later than the end of the third working week of the month, a quarterly report that reviews the monitoring and management response

measures carried out during the previous four months and which shall include, but not be limited to, the following:

8.16.1 Collation of all the monitoring undertaken; and

8.16.2 Details of any triggers that have been exceeded, the management response measures carried out and the results of monitoring after the management response measures have been completed.

8.17 There shall be no fewer than four monthly reports prepared immediately after a Dredging Stage is completed and no fewer than one quarterly report prepared after a Dredging Stage has been completed except that the results of physical monitoring, which is to continue as specified in the table in Appendix 1, are to be reported on in June of each year.

8.18 Within one year of the completion of a Dredging Stage, the CHPT shall provide to the TAG, PRG, ALG and the Consent Authority a Dredging Stage Monitoring Report. The report shall provide a summary of the monitoring and management response measures carried out during the Dredging Stage and shall include, but not be limited, to the following:

8.18.1 Summary of the monitoring undertaken;

8.18.2 Summary of the adaptive management actions carried out and the results of monitoring after the adaptive management actions have been completed; and

8.18.3 Summary of the assurance monitoring completed and an evaluation of whether the biological or physical receiving environment is responding to the Dredging.

8.19 Where any subsequent Dredging Stage is to commence five or more years after the completion of the final quarterly monitoring report prepared under condition 8.17 the CHPT shall prepare:

8.20 The report prepared under condition 8.19 shall be provided to the PRG and the Consent Authority in sufficient time to enable monitoring to be undertaken before the next Dredging Stage.

8.21 Within one month of receiving the written report the PRG shall prepare a response report that accepts, rejects or recommends changes to the recommendations contained in the CHPT Report, but recommended changes may not include a monitoring period in excess of 12 months. The response report shall be provided to the CHPT and the Consent Authority.

9. TURBIDITY TRIGGERS

9A: Establishment of turbidity triggers:

9.1 The consent holder shall establish turbidity triggers for each of the telemetered turbidity monitoring locations. There shall be three tiers of turbidity triggers, each with an Intensity and Allowable Duration value. The purpose of turbidity triggers is:

9.1.1 To initiate an adaptive management action(s) in the event of a Tier 1, 2 or 3 Exceedance which is detailed in the EMMP as required under condition 7; and

9.1.2 For compliance in the case of an Exceedance of the Tier 3 trigger as set out in conditions 9.5 to 9.9.

9.2 The turbidity triggers shall be established in accordance with the methodology (including the modified-Intensity-Frequency-Duration approach) attached in **Appendix 2.**

9.3 Upon completion of the baseline monitoring, the Intensity component of the turbidity triggers for each telemetered turbidity monitoring location shall be calculated using the baseline turbidity data referred to in condition 8.3 or in either condition 8.19 or 8.20 plus the Predicted Dredging Turbidity at that location, using the methodology attached in **Appendix 2**.

9.4 The consent holder shall provide to the Consent Authority, at least two months prior to commencement of a Dredging Stage, a written report prepared by a suitably qualified and experienced expert which demonstrates that the turbidity triggers have been established in accordance conditions 9.2 and 9.3.

9B: Compliance of Tier 3 turbidity trigger

9.5 The telemetered turbidity monitoring locations required under condition 8.4 and 8.5 are to be used to determine when there has been a Tier 3 Exceedance.

9.6 Dredging shall cease or not occur in the vicinity of a telemetered turbidity monitoring location when there is a Tier 3 Exceedance.

9.7 Dredging may only recommence in the vicinity of a telemetered turbidity monitoring location when the Tier 3 Exceedance no longer occurs or alternatively the turbidity reading at the telemetered turbidity monitoring location referred to at condition 9.6 is below the Tier 3 Intensity level identified in the EMMP.

9.8 Notwithstanding condition 9.6, Dredging may continue in the vicinity of a telemetered turbidity monitoring location provided that:

9.8.1 The consent holder provides the Consent Authority a written report, within 24 hours of a Tier 3 Exceedance referred to in condition 9.6, which demonstrates that the elevated turbidity is due to an extraordinary natural event and not attributable to Dredging; and

9.8.2 If the Consent Authority, acting in its technical capacity, disagrees with the findings of the report the Dredging shall cease at the relevant location(s) and only recommence in accordance with condition 9.7. If the Consent Authority provides no written response after two working days then it is deemed that the Consent Authority agrees with the findings of the report prepared under condition 9.8.1 and Dredging may continue.

Advice note: An extraordinary natural event that could cause an Exceedance of the tier-3 trigger defined in the EMMP could include a tsunami, a weather event causing significant flooding, extreme off-shore swells, or a land slip.

9.9 The consent holder shall provide a copy of the report prepared under condition 9.8.1 to the TAG and the PRG and place it on its website.

10. CONSENT HOLDER PROJECT TEAM (CHPT)

10.1 The consent holder shall employ or otherwise engage person(s) to manage the project and implement the conditions of this consent, which includes ensuring that all monitoring information is gathered and disseminated is consistent with the EMMP and in compliance with the conditions of this consent.

10.2 The CHPT shall have the necessary expertise to carry out the following:

10.2.1 Prepare the monthly and quarterly and Dredging Stage monitoring reports and circulate them to the TAG and the PRG and the Consent Authority, as required;

10.2.2 Prepare any other report required under condition 8;

10.2.3 Assess monitoring data to ensure it meets requirements and is continually being gathered;

10.2.4 Ensure that the dredging contractor has all access to all monitoring information and that adaptive management actions are being initiated and implemented in a timely manner.

11. **TECHNICAL ADVISORY GROUP (TAG)**

11.1 The consent holder shall establish, at its own cost, a TAG, which is to review the monitoring reports and provide technical advice to the CHPT on whether the monitoring programme at 8.1 is fit for purpose.

11.2 The consent holder shall establish a TAG at least three months prior to the first commencement of dredging.

11.3 The TAG shall comprise no more than 12 members as detailed below.

Tangata Whenua

11.4 The consent holder shall offer Tangata Whenua the opportunity to have up to three members consisting of the following expertise:

11.4.1 A person knowledgeable and reputable with regard to mahinga kai;

11.4.2 A suitably qualified and experienced specialist in marine ecology and/or water quality, including turbidity; and

11.4.3 A person knowledgeable and reputable with regard to tikanga Maori.

Marine Farming Technical Representative

11.5 The consent holder shall offer the opportunity to have two technical representatives of the local marine farms consisting of the following expertise:

11.5.1 A suitably qualified person who has direct experience in operating a marine farm and is currently managing or operating a marine farm in the vicinity of the project; and

11.5.2 A suitably qualified person, experienced in assessing environmental effects of or on aquaculture activities or one of the disciplines referred to in condition 11.6.

Consent Holder

11.6 The consent holder may have up to seven members consisting of the following expertise:

11.6.1 A suitably qualified and experienced specialist in marine ecology;

11.6.2 A suitably qualified and experienced specialist in aquaculture;

11.6.3 A suitably qualified and experienced specialist in monitoring the marine environment;

11.6.4 A suitably qualified and experienced specialist in hydrodynamic modelling;

11.6.5 A suitably qualified statistician having experience in natural resource management; and

11.6.6 No more than two other members of the CHPT.

11.7 The TAG shall:

11.7.1 Review the monthly, quarterly and Dredging Stage monitoring reports prepared by the CHPT and where necessary provide advice to the CHPT in writing on whether the monitoring programme detailed in the EMMP requires amendment (including the location of monitoring stations and the parameters monitored for);

11.7.2 Review any exceedances of the turbidity triggers contained in the EMMP and where necessary provide written advice to the CHPT on whether the monitoring programme detailed in the EMMP needs to be amended to better understand whether exceedances are attributed to Dredging or other environmental parameters; and

11.7.3 Provide advice on any other technical matters as sought by the Consent Holder.

11.8 The consent holder shall provide any administrative support necessary for the TAG to carry out itsfunctions.

11.9 Where the TAG does not have the expertise in any of the areas on which it is required to report on, it may engage the services of an appropriate expert to advise on a relevant matter to the TAG.

12. AQUACULTURE LIAISON GROUP (ALG)

12.1 No more than three months following the commencement of this consent and not less than three months prior to exercising this consent, the consent holder shall invite representatives of the aquaculture industry to participate in an ALG.

12.2 The purposes of the ALG are:

12.2.1 To enable the consent holder and the aquaculture industry to share information relating to the exercise of these consents;

12.2.2 To discuss the monitoring required by this consent, insofar as it relates to the effects of exercising this consent on Authorised Marine Farming activities, including but not limited to the matters covered in conditions 7.11.2, 8.5.2, 11.7.1 and 11.7.2; and

12.2.3 To ensure that any adverse effects on Authorised Marine Farming activities, are avoided or remedied.

12.3 Invitations to participate in the ALG shall be extended to:

12.3.1 Sanford Limited; and

12.3.2 Authorised Marine Farmers from Northern Banks Peninsula.

12.4 Sanford Limited shall be entitled to appoint one representative to the ALG.

12.5 The Authorised Marine Farmers from Northern Banks Peninsula shall be entitled to appoint three representatives to the ALG.

12.6 The consent holder shall be entitled to appoint up to three representatives to the ALG.

12.7 Once established, the consent holder shall offer to hold meetings of the ALG at least once prior to first exercising this consent, every three months thereafter until Dredging first commences, at least three monthly in the first 12 months after the commencement of each Dredging Stage and at least every six months at all other times.

12.8 The costs of participation in the ALG shall lie where they fall, except that all administration costs will be the responsibility of the consent holder.

12.9 The consent holder shall provide no less than two weeks' notice of all ALG meetings and shall keep minutes of these meetings and distribute them within five working days.

12.10 The consent holder shall ensure that the ALG is given an opportunity to provide input into the preparation of the management plans required under conditions 4, 6 and 7. Any written recommendations from the aquaculture representatives on the ALG that are not included in the final management plans shall be provided to the Consent Authority at the same time as the plan is lodged under conditions 4.1, 6.1 and 7.1.

13. **PEER REVIEW GROUP (PRG)**

13.1 The consent holder shall establish, at its own cost, a PRG for the following purposes:

13.1.1 To review the EMMP and any amendments to the EMMP and provide written advice to the Consent Authority as to its suitability for Certification;

13.1.2 Provide written advice to the Consent Authority after a Dredging Stage on whether any particular condition(s) should be subject to review; and

13.1.3 Provide written advice to the Consent Authority on whether the monitoring-related reports have been prepared in accordance with the EMMP and in compliance with the conditions of this consent.

13.2 The PRG shall comprise three persons who shall be:

13.2.1 Independent of the consent holder (and without restricting the generality of that requirement, shall not be an employee of the consent holder or a related company, nor a person regularly contracted to research and write for the consent holder through another company);

13.2.2 Scientists who, between them, have experience across the following scientific areas:

a. marine ecology, including aquaculture and other seafood resources;

b. coastal processes;

c. hydrodynamic modelling;

-: and are recognised by their peers as having such experience, knowledge and skill; and

13.2.3 The scientists described on condition 13.2.2 shall be approved in writing by the Consent Authority before they may commence the functions required by this consent.

13.3 Where the PRG does not have the expertise in any of the areas it is required to report on, it may, following consultation with the CHPT, engage the services of an appropriate expert to report on the relevant matter to the PRG. Any report from such an expert shall form part of a report provided by the PRG as required by these conditions.

13.4 The PRG shall be established at least two months prior to the commencement of Dredging.

13.5 As part of undertaking its functions, the PRG shall provide an opportunity for the CHPT and TAG to meet or submit to them on any matter that the PRG is required to consider.

13.6 The PRG shall:

13.6.1 Prepare a written report on whether the EMMP or amendments thereof have been completed in accordance with conditions 7, 8 and 9 and include a

recommendation to the Consent Authority whether the EMMP or amendment can be certified;

13.6.2 Where Certification is not recommended, explain the reasons why and provide recommendations on what, in the opinion of the PRG, needs to be changed in order for the EMMP or an amendment thereof to be certifiable; and

13.6.3 Provide written advice to the Consent Authority on whether the following reports have been prepared in accordance with the EMMP, and in compliance with the conditions of this consent:

13.6.4.1 Baseline monitoring report prepared under condition 8.13;

13.6.4.2 The quarterly monitoring reports prepared under condition 8.16;

13.6.4.3 The Dredging Stage Monitoring Report prepared under condition 8.18; and

13.6.4.4 Receive any report on a Tier 3 turbidity trigger prepared under condition 9.12.

13.6.4 The PRG shall, after receiving the Dredging Stage Monitoring Report under condition 8.18 prepare a review for the consent holder and the Consent Authority. The review shall assess the quarterly monitoring reports together with the Dredging Stage Monitoring Report and the EMMP, to determine whether the existing conditions of consent are appropriate or whether a change to one or more of the conditions is required, and the reasons why. The PRG shall consult with the CHPT and the TAG before making its recommendations to the consent holder and the Consent Authority.

13.6.5 The consent holder shall within two months of receiving the review from the PRG prepare a report to the Consent Authority that states whether or not a change or cancellation of consent condition is appropriate and provide detailed reasons for its conclusion.

Advice Note: The consent holder will consider applying for a change or cancellation of consent condition pursuant to s127 of the Resource Management Act 1991 if it determines it is appropriate.

13.7 The consent holder shall ensure all written communications from the PRG to the Consent Authority are placed on the consent holder's website as required under condition 14.

13.8 The consent holder shall provide any administrative support necessary for the PRG to carry out its functions.

14. WEBSITE OBLIGATIONS

14.1 The consent holder shall maintain a website that is accessible to, and readily usable by, the public at least six months prior to the first commencement of Dredging;

14.2 The website shall include, but not be limited to, the following information:

14.2.1 A summary of real-time data collected from the telemetered stations required under conditions 8.4, 8.5 and 8.11 of this consent;

14.2.2 Monthly monitoring reports prepared under condition 8.15 of this consent;

14.2.3 Quarterly monitoring reports prepared under condition 8.16 of this consent;

14.2.4 Any Tier 3 turbidity trigger report prepared under condition 9.12 of this consent;

14.2.5 The DMP, MMMP, BMP and the EMMP and any amendments thereof; and

14.2.6 All written reports and reviews prepared by the TAG or PRG under conditions 11 and 13 respectively.

15. COMPLAINTS

15.1 A record of complaints relating to any activity associated with Dredging shall be maintained. Each record, where practicable, shall include:

15.1.1 The location of the reported nuisance or effect;

15.1.2 The date and time of the complaint;

15.1.3 A description of the weather conditions at the time of complaint, if relevant;

15.1.4 Any possible cause of the nuisance or effect; and

15.1.5 Any management actions undertaken to address the cause of the complaint and the name of the complainant, if offered.

15.2 The record of complaints shall be provided to the Consent Authority Manager every four months or on request.

15.3 An aggregated summary of the complaints received for each month shall be provided to the TAG no later than the end of the following month.

16. **ACCIDENTAL DISCOVERY PROTOCOL**

16.1 In the event of any discovery of archaeological material, the consent holder shall immediately:

16.1.1 Cease Dredging operations in the affected area, and mark off the affected area using GPS coordinates on the dredge vessel; and

16.1.2 Advise the Consent Authority of the disturbance; and

16.1.3 Advise the Southern Regional Office of Heritage New Zealand of the disturbance.

16.2 If the archaeological material is determined to be koiwi tangata (human bones) or taonga (treasured artefacts) by Heritage New Zealand, the consent holder shall immediately advise the office of Te Hapū o Ngāti Wheke of the discovery.

16.3 If the archaeological material is determined to be koiwi tangata (human bones) by the Heritage New Zealand, the consent holder shall immediately advise the New Zealand Police of the disturbance.

16.4 Dredging may only recommence within the marked location if the Consent Authority provides a written statement to the consent holder that it is appropriate to do.

Advice Note: The Consent Authority will make a decision on whether it is appropriate to recommence Dredging in the location having regard to the consultation carried out with Heritage New Zealand and with Te Hapū o Ngāti Wheke if the site is of Māori origin and the action taken on the archaeological material discovered.

Appendix 1: Table of Monitoring and frequency of monitoring

Type of monitoring	Parameter	During Baseline and During Dredging		After Dredging Stage
		Monitoring	Collection	
Real Time Monitoring (Turbidity and WaterQuality) For the purposes of this table "telemetered" means the delivering of the monitoring data electronically to LPC as the data is recorded unless otherwise specified in the table	Turbidity (NTU)	At least every 30 minutes	Telemetered Logged and collected	4 months
	Benthic PAR (Mol/m^2/d)	At least every 30 minutes	Monthly	
	Bed Level (altimeter)	At least every 30 minutes	Monthly	
	pH	At least every 30 minutes	Telemetered or Logged and	
	• Temperature • Conductivity • Dissolved Oxygen	At least every 30 minutes	Telemetered or Logged and collected	
	Water dynamics (current speeds and direction and waves)	At least every 30 minutes	Telemetered Sent 6-hourly	
Sample/Survey (Water Quality and Ecology)	Nutrients (phosphorus and nitrogen) and chlorophyll a (µg/L)	Monthly		Monthly for four months
	Total and dissolved metals (µg/L)	Monthly		
	TSS mg/L	Monthly		
	Organic chemicals − 22 individual acid herbicides - 179 individual multiresidue pesticides - Total petroleum hydrocarbons and BTEX	6-Monthly		One survey within 4 months of dredging ceasing
	Soft-Sediment Benthic	4-Monthly Survey (subject to weather conditions)		One survey within 4-6 months of dredging ceasing and one survey between 8-12 months from dredging

Type of monitoring	Parameter	During Baseline and During Dredging		After Dredging Stage
		Monitoring	Collection	
	Shoreline Ecology • Sub-tidal • Inter-tidal			ceasing
	Underwater Acoustic Monitoring	Continuously	Logged and collected Monthly	For a period of 3 months
Monitoring of Physical Parameters	Photo-point monitoring[1]	3-monthy		3-monthly for first 2 years 6-monthly for the following 3 years
	Sediment size analysis[2]	6-monthly		6-monthly for first 2 years Annually for the following 3 years
	Beach profile survey[3]	6-monthly		6-monthly for 5 years
	Shoreline analysis[4]	A Baseline assessment of historical shoreline (Lyttelton harbour only) Annually for five years as aerial photographs/satellite imagery become available		
	Seabed (Bathymetric) Survey	Annually		Annually for 5 years

[1] To visually assess beach level change or fine sediment deposition from fixed locations and aspects
[2] To quantify sediment size on beach to determine changes in texture and composition
[3] To quantify changes in profile geometry and/or location from an established benchmark
[4] To determine changes in shoreline position using aerials photographs or satellite imagery

Survey requirements to achieve beach profile:

- Survey using staff and level, total station or RTKGPS
- Survey during spring low tide, pick up all changes in-grade
- Required horizontal accuracy +/- 0.1m, vertical accuracy of +/- 0.05m

An Unmanned Aerial Vehicle (UAV) survey may be used in place or augment photo-point monitoring, beach profile survey and shoreline analysis.

Bathymetric survey accuracy shall be +/- 0.1m to +/- 0.5m in the vertical and horizontal directions respectively for comparable to every other survey undertaken in the same location. The error for each reading is expected to be in the order of 2-8 cm.

Statistical methodology outline – Development of Intensity component of Turbidity Triggers

The below is a summary of the methodology set out in the Environmetrics Australia Report: *Statistical Considerations Associated with the Establishment of Turbidity Triggers: Candidate Methodologies for Large Scale Dredging Projects dated 11 May 2017*

Step 1: Raw data collected by turbidity monitoring stations and sent via telemetry to data warehouse facility.

Step 2: Raw data undergoes preliminary inspection and quality assurance using a combination of both manual and automated processing tools to produce *functionally-assured (F-qaqc)* data.

The purpose of the *F-qaqc* step is to check the consistency and integrity of the data obtained from the monitoring instruments and, where appropriate, to take remedial action. These activities include, but are not limited to:

- Flagging and if necessary, removing readings obtained when equipment was known to be faulty, unreliable, or unserviceable;
- Flagging, but **not** removing readings obtained during adverse weather or oceanographic conditions;
- In the case of dual-instrument deployments, aggregating readings in accordance with agreed protocols;
- Implementing agreed protocols in the case of instrument failure for a dual-instrument deployment.

Step 3: Functionally-assured data then is subjected to rigorous analysis using a variety of statistical procedures to produce *statistically assured data*. Activities within this step include:

1. Identify extreme and unusual data in terms of their *statistical* properties and address as required;
2. Use statistical data imputation techniques in accordance with agreed protocols to overcome problems created by blocks of missing data;
3. Apply the Kolmogorov-Zurbenko (KZ) filter, in accordance with agreed protocols, to attenuate the influence of extreme, transient observations; and

Step 4: Establish TSS-NTU relationship(s)

In order to assimilate the modelled turbidity data (in units of mg/L) with the monitoring data (in NTU) models describing the TSS-NTU relationship need to be established. This involves:

1. Using the complete baseline data record of depth-profiling data at all sites to establish the relationship between sub-surface total suspended sediment concentrations (in mg/L) and contemporaneous measurements of NTU;
2. Additional statistical analysis to establish whether significant spatial variations in the empirical TSS-NTU relationship are evident. If this is the case, *separate* (site-specific) TSS-NTU

models will be used in step 5 below; if not – a single 'omnibus' TSS-NTU model will be used in step 5 below.

Step 5: Convert the modelled data to NTU and combine with measured baseline

1. The TSS-NTU relationship(s) from step 4 will be applied to the modelled TSS concentrations (for an indicative year for the harbour model and for 10 years for offshore model) at each monitoring location to convert predicted TSS concentrations into NTU. At each monitoring site, the timestamp on the modelled output will be used to match a converted TSS value with the measured turbidity obtained at the same day, month, and hour during the baseline monitoring campaign;
2. The converted TSS and baseline NTU values obtained at step 5.1 will be added together to obtain a time-series (annual or longer) of ***total turbidity*** in NTU at each monitoring location;
3. The ***total turbidity*** data obtained at step 5.2 will be used as the basis for determining trigger values for each monitoring location.

Step 6: Calculate the *Intensity* parameters for each site for all three tiers

1. Using the *total turbidity* data at each monitoring location, calculate the Intensity (NTU) for each tier as the relevant percentile in Table 1 of the data obtained in step 5.3

Table 1

Turbidity Trigger	Intensity level $(1-\alpha)$	Nominal Intensity Trigger	Intensity (NTU)	Allowable duration of exceedance (hours) per rolling 30 day period
Tier 1	0.8	$Y_{(1-\alpha)}^{(1)}$	$I_{(1-\alpha)}^{(1)}$	144
Tier 2	0.95	$Y_{(1-\alpha)}^{(2)}$	$I_{(1-\alpha)}^{(2)}$	36
Tier 3	0.99	$Y_{(1-\alpha)}^{(3)}$	$I_{(1-\alpha)}^{(3)}$	7.2

2. For a chosen intensity level $(1-\alpha)$ determine the nominal intensity triggers, $Y_{(1-\alpha)}^{(i)}$, $i=1,2,3$;
3. For a nominal intensity trigger $Y_{(1-\alpha)}^{(i)}$ determine the corresponding upper limit $I_{(1-\alpha)}^{(i)}$ such that the probability that the $(1-\alpha)$ percentile of a sample of *n* filtered turbidity readings (obtained at the end of step 3) exceeding $I_{(1-\alpha)}^{(i)}$ is no more than 1% The determination of $I_{(1-\alpha)}^{(i)}$ shall be based on part (c) of Theorem 7.1 in DasGupta (2008) . The upper limits $\left\{ I_{(1-\alpha)}^{(i)}, i=1,2,3 \right\}$ so determined are referred to as *'intensity'* and form the basis of all monitoring and compliance activities.

CRC172456 – A Coastal Permit under section 12 of the Resource Management Act 1991:

1: To dredge (disturb) seabed material for the purposes of maintaining the depth of a shipping (navigation) channel that includes a ship-turning basin, and berth pockets to the extent authorised by CRC172455; and

2: To deposit seabed material on the seabed associated with 1 above.

CRC172523 – A Discharge Permit under sections 15, 15A and 15B of the Resource Management Act 1991:

1: To discharge contaminants (seabed material and water) into water associated with maintenance dredging as described in CRC172456;

2: To discharge (dump) dredge material from a ship into water at the maintenance disposal grounds as described in CRC172456; and

3: To discharge contaminants (seabed material and water) from a ship into water associated with maintenance as described in CRC172456.

TERM OF CONSENT

The duration of consent shall be 35 years.

General Advice Note on Conditions

1 The conditions below apply to both CRC172456 and CRC172523
2 The Plans attached to and forming part of this consent apply to CRC172456 and to CRC172523

CONDITIONS OF CONSENTS

DEFINITIONS

For the purposes of this consent the following definitions shall apply:

"**ALG**" means the Aquaculture Liaison Group;

"**Allowable Duration**" is the maximum number of hours in a rolling 30 day period during which the Intensity prescribed at a telemetered turbidity monitoring location in relation to turbidity trigger Tiers 1, 2 or 3 may be exceeded without a management action being required. The maximum number of hours for each Tier is as follows:

Tier 1: 144

Tier 2: 36

Tier 3: 7.2;

"**Authorised Marine Farm**" means any marine farm that, as at the date this consent is first exercised, exists or which holds an existing but unimplemented resource consent. Authorised Marine Farming Activity has the same meaning;

"**Authorised Marine Farmer**" means any person who operates an Authorised Marine Farm;

"**BMP**" means the Biosecurity Management Plan;

"**Certification**" means that the DMP, BMP, and EMMP meet all the requirements set out in the conditions of the relevant resource consent(s);

"**CHPT**" means the Consent Holder Project Team;

"**Consent Authority**" means the Canterbury Regional Council or any successor;

"**Consent Authority Manager**" means the Canterbury Regional Council, Attention: Regional Leader, Compliance and Monitoring;

"**CRMS**" means Craft Risk Management Standard;

"**DMP**" means the Dredge Management Plan;

"**Dredge Spoil**" means seabed material that has been removed by a dredge and is to be disposed of at the designated spoil disposal ground;

"**Dredging**" means dredging to maintain depths of the Shipping Channel;

"**Dredging Campaign**" means the period when a dredge is deployed at Lyttelton to carry out maintenance dredging;

"**EMMP**" means the Environmental Monitoring and Management Plan;

"**Exceedance**" means the exceedance of an Allowable Duration;

"**IHS**" means Import Health Standard;

"**Intensity**" means the turbidity level (in NTU) established for each Tier at each telemetered turbidity monitoring location using the methodology contained in Appendix 1 and the following percentiles:

Tier 1: 80%

Tier 2: 95%

Tier 3: 99%;

"**Navigation Channel**" means the navigation channel, ship turning basin, and berthage areas;

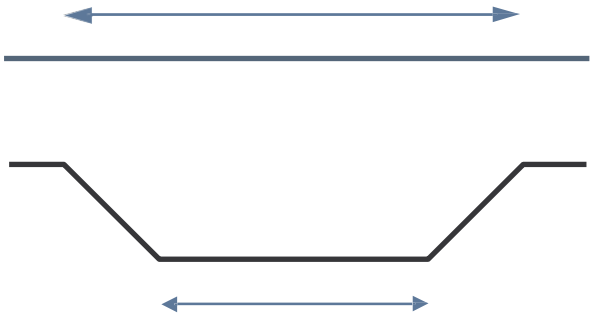
"**Northern Banks Peninsula**" (in the context of marine farms) means those marine farms that are authorised at the date of the first exercise of this consent and are located to the west of a line between Motunau and Steep Head;

"**NTU**" means nephelometric turbidity unit;

"**Predicted Dredging Turbidity**" means the TSS from the Dredging that is predicted from the hydrodynamic modelling detailed in Appendices 9 and 11 of the Assessment of Environmental Effects supporting the application lodged on 28 September 2016;

"**Shipping Channel**" means the Navigation Channel (see diagram below) and includes all batter slopes;

Shipping channel width (including batter slope)



Navigation channel width

(Cut view of channel)

"**TAG**" means the Technical Advisory Group;

"**Tangata Whenua**" means Te Hapu o Ngati Wheke (Rapaki), Te Runanga o Koukourarata and Te Runanga o Ngai Tahu;

"**TSS**" means Total Suspended Solids.

1. LOCATION

1.1 Dredging operations, in order to maintain the depth and extent of the Navigation Channel marked on Plan CRC172456A (attached to and forming part of this consent) shall occur within the Shipping Channel. Dredging of the Inner Harbour is excluded by this consent.

Advice Note: *Dredging of the Inner Harbour is authorised under CRC135318*

1.2 The discharge (dumping) of Dredge Spoil shall occur within the area of the offshore maintenance disposal ground or the Godley Head maintenance disposal ground marked on Plan CRC172456A.

1.3 The Godley Head maintenance disposal ground shall only receive Dredge Spoil in the following circumstances:

1.3.1 The offshore maintenance disposal ground cannot be used due to rough sea-state conditions; or

1.3.2 The vessel used to transport Dredge Spoil is insufficiently sea worthy to dispose of sediment outside the head.

1.4 Notwithstanding condition 1.3, the maximum amount of Dredge Spoil disposed of at the Godley Head maintenance disposal ground, measured in tons, shall not exceed 167,000 tons per annum

***Advice note*:** The tons of dredge spoil shall be calculated, for each disposal event, from an empirical relationship between the loaded displacement of the dredger and hopper volume. The total annual maximum of 167,000 tons is equivalent to a 100,000 cubic metre in-situ volume with a wet density of 1.67 tons per cubic metre.

2. ADMINISTRATION

2.1 The Consent Authority may, on any of the last five working days of May and November, serve notice of its intention to review the conditions of this consent for the purposes of:

2.1.1 Dealing with any adverse effect on the environment which may arise from the exercise of this consent;

2.1.2 Amending the monitoring programmes required by this consent, including adding or deleting monitoring site locations and adding or deleting specific monitoring parameters;

2.1.3 Amending the real-time turbidity monitoring, turbidity triggers and the adaptive management actions after a Dredging Campaign should the monitoring reveal an unforeseen effect that is attributable to Dredging;

2.1.4 Require the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.

2.2 The lapsing date for the purposes of section 125 shall be 12 years after the commencement of the consent.

3. **NOTIFICATION AND RECORDS**

3.1 The consent holder shall notify the Consent Authority at least one month prior to the commencement of the first Dredging campaign. The consent holder shall keep records detailing the timing, quantities and location of seabed material dredged, and also of the Dredge Spoil disposed of within the offshore and Godley Head maintenance disposal grounds and detail the reasons why Godley Head disposal ground was used. These records shall be submitted to the Consent Authority Manager within one month of cessation of a Dredging Campaign.

4. **DREDGE MANAGEMENT PLAN (DMP)**

4.1 At least three months prior to the commencement of the first Dredging Campaign the CHPT shall provide the TAG a copy of a Draft DMP.

4.2 At least one month prior to the commencement of the first Dredging Campaign the consent holder shall provide to the Consent Authority Manager a DMP. A copy of the DMP shall be provided at the same time to the Tangata Whenua, the TAG and the ALG as it is provided to the Consent Authority.

4.3 The purpose of the DMP shall be to specify how Dredging practices and procedures will ensure that any actual or potential adverse effects on the marine receiving environment are avoided or otherwise mitigated to the greatest extent practicable.

4.4 The DMP shall include, but not be limited to, the following:

4.4.1 A description of the dredge to be used;

4.4.2 A description of Dredging methodology typically used;

4.4.3 A description of how the location and quantities of Dredge Spoil are recorded;

4.4.4 A description of the maintenance of equipment and systems;

4.4.5 A description of the storage and handling of hazardous substances;

4.4.6 A description of a turbulence reducing (green or environmental) valve to be incorporated with the overflow system of the maintenance dredge vessel using the offshore maintenance spoil disposal ground;

4.4.7 In relation to marine mammals, details on:

a. The requirement for a regular crew member on the dredge to be a designated marine mammal observer, whose role includes record keeping;

b. The training to be provided to the designated observer, which is to be delivered by a suitably qualified marine mammal expert;

c. Guidelines for the vessel, including speed limits, to reduce any chances of mortality from vessel strikes with whales, particularly the southern right whales; and

d. Provision of information protocols with the Department of Conservation during Dredging to help anticipate any potential seasonal interactions with any whale species sighted; and

4.4.8 A description of all other necessary measures to avoid or mitigate any actual or potential adverse effects on the receiving environment to greatest extent practicable during the operation of the dredge, including measures on the management of :

a. Biofouling;
b. Waste;
c. Refuelling; and
d. Overflow;

4.4.9 Those matters in condition 4.4.7 shall be prepared by a person who is suitably qualified and experienced in managing potential adverse effects on marine mammals.

Certification of DMP

4.5 The DMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved DMP.

4.6 Any amendment to the DMP shall be approved in writing by the Consent Authority Manager in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended DMP.

4.7 A copy of the DMP and all amended DMPs shall be provided to Tangata Whenua, the TAG and the ALG immediately following Certification.

5. **BIOSECURITY MANAGEMENT PLAN (BMP)**

5.1 If the consent holder deploys the maintenance dredge vessel directly from overseas then a BMP is required to be prepared and implemented in accordance with conditions 5.2 to 5.8.

5.2 At least two months prior to the arrival of the dredge vessel in New Zealand, the consent holder shall provide a BMP to the Consent Authority. A copy of the BMP shall be provided at the same time to Tangata Whenua, the TAG and the ALG as is provided to the Consent Authority.

5.3 The purpose of the BMP shall be to reduce the risk of a biosecurity incursion to the greatest extent practicable.

5.4 The BMP shall include, but not be limited to, the following:

5.4.1 A description of the dredge vessel and its attributes that affect risk, including key operational attributes (e.g. voyage speed, periods of time idle), maintenance history (including prior inspection and cleaning undertaken), and voyage history since last dry-docking and antifouling (e.g. countries visited and duration of stay);

5.4.2 A description of the key sources of potential marine biosecurity risk from ballast water, sediments and biofouling. This should cover the hull, niche areas, and associated equipment, and consider both submerged and above-water surfaces;

5.4.3 An assessment of the biosecurity risks to Authorised Marine Farming Activities from activities authorised by this consent and the methods to be used to minimise those risks to the greatest extent practicable.

5.4.4 Findings from any previous inspections;

5.4.5 A description of the risk mitigation taken prior to arrival in New Zealand, including but not limited to:

5.4.5.1 Routine preventative treatment measures and their efficacy, including the age and condition of the antifouling coating, and marine growth prevention systems for sea chests and internal sea water systems;

5.4.5.2 Specific treatments for submerged and above-water surfaces that will be undertaken to address IHS and CRMS requirements prior to departure for New Zealand. These could include, for example, in-water removal of biofouling, or above-water cleaning to remove sediment;

5.4.5.3 Additional risk mitigation planned during transit to New Zealand, including expected procedures for ballast water management;

5.4.5.4 Expected desiccation period of above-water surfaces on arrival to New Zealand (i.e. period of air exposure since last dredging operations);

5.4.6 The nature and extent of pre-border inspection that will be undertaken (e.g. at the overseas port of departure) to verify compliance with IHS and CRMS requirements; and

5.4.7 Record keeping and documentation of all mitigation undertaken (i.e. prior to and during transit to New Zealand) to enable border verification if requested by Ministry for Primary Industries or its successor, and to facilitate final clearance.

5.5 The BMP shall be prepared by a person who is suitably qualified experienced in managing the risk of biosecurity incursions and shall be appointed by the consent holder following consultation with the ALG.

Certification of BMP

5.6 The BMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved BMP.

5.7 Any amendment of the BMP shall be approved in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended BMP.

5.8 A copy of the BMP and all amended BMPs shall be provided to Tangata Whenua, the TAG and the ALG immediately following Certification.

6 ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN (EMMP)

6.1 At least three months prior to the commencement of the first Dredging Campaign the CHPT shall provide the TAG a copy of a Draft EMMP.

6.2 At least two months prior to the commencement of the first Dredging Campaign, the consent holder shall provide an EMMP to the Consent Authority for Certification. A copy of the EMMP shall be provided at the same time to Tangata Whenua, the TAG and the ALG as it is provided to the Consent Authority.

6.3 The purpose of the EMMP is to detail how:

(a) Turbidity monitoring and adaptive management actions are implemented to minimise the risk of elevated turbidity that can be attributed to disposal of dredge material at the offshore maintenance disposal grounds, causing adverse effects on sensitive receptors including Authorised Marine Farms;

(b) Assurance monitoring is implemented to evaluate any actual or potential biological and physical effects and compare them with those predicted effects in the information filed in support of the application; and

(c) The circumstances when turbidity and adaptive management action requirements may cease and the frequency of the assurance monitoring that may be reduced.

6.4 The EMMP shall, at a minimum, address the following topics:

(a) The monitoring of turbidity plumes;

(b) Adaptive management actions to be undertaken in response to an exceedance of a turbidity trigger;

(c) Assurance monitoring, including in respect of Authorised Marine Farms;

(d) Reporting requirements;

(e) Roles and responsibilities of groups involved in monitoring and any adaptive management actions;

(f) Identifying any other relevant management plans; and

(g) Documenting procedures for handling complaints.

Monitoring of Turbidity

6.5 As part of the EMMP, the consent holder shall detail how turbidity plumes are to be monitored to:

(a) Confirm whether or not turbidity exceeds the specified turbidity triggers that are to be specified under condition 6.8; and

(b) Assess the relative contributions of Dredging and non-Dredging sources to observed turbidity.

6.6 The EMMP shall include, but not be limited to, the following details:

(a) The turbidity monitoring equipment to be used;

(b) The location of the monitoring equipment;

(c) The setting up and maintenance of monitoring equipment;

(d) The establishment of real-time monitoring that can be made readily accessible to the TAG and PRG through reporting or notification emails, and a summary of the real-time turbidity monitoring that is readily accessible on the web for the community generally; and

(e) Data management.

Adaptive Management Actions in Response to Turbidity Plumes

6.7 As part of an EMMP, the consent holder shall detail the adaptive management actions to be carried out in response to elevated turbidity as defined by the turbidity triggers.

6.8 To achieve condition 6.7, the EMMP shall include, but not be limited to, the following:

(a) Details of the rationale for classifying the turbidity observations into three tiers of turbidity triggers;

(b) Details of how the Tier 1, Tier 2 and Tier 3 turbidity triggers are determined using the methodology referred to in conditions 8.2.

(c) Setting out the Intensity values for Tier 1, Tier 2 and Tier 3 turbidity triggers which are based on the 80th, 95th, and 99th percentile of baseline plus Predicted Dredge Turbidity respectively; and

(d) Description of the adaptive management actions during disposal at the offshore maintenance disposal ground and how they may be applied by the dredge operator when a Tier 1, Tier 2 or Tier 3 turbidity trigger is exceeded, and a description of the compliance requirements for a Tier 3 exceedance as specified under condition 8.10.

Assurance Monitoring

6.9 The consent holder shall monitor the receiving environment to evaluate how the marine ecology and the physical environment is responding to Dredging Campaigns and confirm that Dredging related suspended solids are not adversely affecting Authorised Marine Farms and other sensitive receptors.

6.10 The EMMP shall include, but not be limited to, the following:

(a) Sub-tidal, intertidal, and benthic ecological surveys that will be carried out after a Dredging Campaign;

(b) Water quality monitoring that will be carried out during a Dredging Campaign;

(c) Bathymetric surveys and physical shoreline monitoring that will be carried out after a Dredging Campaign; and

(d) Inspections of marine farms, where necessary.

Reporting Requirements

6.11 As part of the EMMP, the consent holder shall detail the reporting requirements specified in the conditions of consent and otherwise needed to achieve the purpose of the EMMP.

Other Management Plans

6.12 As part of the EMMP, the consent holder shall list the other Plans prepared under this consent.

Certification of EMMP

6.13 The EMMP shall be certified in writing by the Consent Authority Manager acting in a technical Certification capacity prior to the first commencement of Dredging authorised by this consent and the consent holder shall undertake all activities authorised by this consent in accordance with the approved EMMP.

6.14 Any amendment of the EMMP shall be certified in writing by the Consent Authority Manager acting in a technical Certification capacity and the consent holder shall undertake all activities authorised by this consent in accordance with the amended EMMP.

6.15 A copy of the certified EMMP and all amended EMMPs shall be provided to Tangata Whenua and the ALG immediately following Certification.

7 MONITORING

7.1 The consent holder shall prepare and undertake monitoring programmes in accordance with these conditions.

7.2 The monitoring programmes shall be designed and carried out by a person(s) suitably qualified and experienced in the monitoring of the marine environment.

Five Yearly Monitoring of Lyttelton Harbour (including Godley Head Area)

7.3 The consent holder shall carry out surveys to monitor the effects of the disposal of Dredge Spoil at the Godley Head maintenance disposal ground and the offshore maintenance disposal grounds marked on Plan CRC172456A (attached to and forming part of this consent).

7.4 The monitoring surveys shall be carried out by the consent holder at five yearly intervals with the first survey being completed no later than 2020 and the subsequent monitoring surveys shall be carried out at five yearly intervals thereafter.

7.5 If no Dredging Campaign is performed during the year when the five yearly monitoring survey is due under condition 7.4, the monitoring survey shall be carried out in the next year that a Dredging Campaign is undertaken, and the subsequent monitoring survey shall be carried out at five yearly intervals thereafter.

7.6 The consent holder shall complete the monitoring survey between four and six months after the cessation of a Dredging Campaign.

7.7 The monitoring survey shall include, but not be limited to, the benthic stations DD01, DD02b, DD03, DD04b, DD05, DD06b, DD07b, DD08b, DD09, DD10, DD11, DD12 inter-tidal stations DD03-Int and DD12-Int and two bioaccumulation stations at Gollans Bay and Rapaki Bay shown on marked on Plan CRC172456B attached to and forming part of this consent.

7.8 The monitoring survey shall include, but not be limited to, sampling for the following:

(a) Sediment physico-chemical characteristics (including trace contaminants);

(b) Presence and abundance of benthic macrofauna; and

(c) Presence and abundance of inter-tidal flora and fauna.

Advice Note: The five yearly monitoring surveys required under this consent mirrors the five yearly monitoring surveys required under CRC135318. In other words each five yearly survey required to be undertaken pursuant to this consent will also satisfy the requirements under CRC135318.

Baseline Turbidity applied for the Offshore Maintenance Disposal Ground

7.9 The baseline turbidity conditions at the offshore maintenance disposal ground shall be established using the baseline turbidity information required to be obtained under condition 8.3 and reported on under condition 8.13 of CRC172455 and CRC172522 (channel deepening consent).

7.10 The consent holder shall prepare a report setting out the baseline turbidity conditions for the offshore maintenance disposal ground in accordance with condition 7.9 and the report shall be provided to the TAG, ALG and

the Consent Authority no less than three months prior to commencement of the first Dredging Campaign authorised by this consent.

Turbidity and Associated Water Quality Monitoring of the Offshore Maintenance Disposal Ground during a Dredging Campaign

7.11 The consent holder shall monitor for turbidity plumes generated from the disposal of spoil at the offshore maintenance disposal ground, and shall monitor for water quality, for the duration of each Dredging Campaign.

7.12 There shall be no fewer than two stations carrying out the telemetered monitoring of turbidity (NTU) and the monitoring of water quality. The stations shall be located in the Instrumentation Zones shown on marked on Plan CRC172456C attached to and forming part of this consent.

7.13 There shall be no less than one station measuring currents.

7.14 The consent holder shall monitor for turbidity and monitor for water quality during a Dredging Campaign at the frequency set out in Table 1. The specific location of the monitoring stations, and the methodology and equipment to be used shall be detailed in the EMMP

7.15 The turbidity and water quality monitoring required under conditions 7.11 to 7.14 may cease after a period of not less than five years from the commencement of the first Dredging Campaign provided that there has also been three continuous years where there has not been a recorded Tier 3 Exceedance.

Table 1: Turbidity and water quality to be monitored and the frequency of monitoring during a Dredging Campaign

Parameter	Monitoring Frequency	Collection Frequency
Turbidity (NTU)	At least every 30 minutes	Telemetered[1] or Logged and collected monthly
TSS mg/L	Monthly	Monthly
Current speeds and direction	At least every 30 minutes	Telemetered Sent 6-hourly
pH	At least every 30 minutes	Telemetered or Logged

Parameter	Monitoring Frequency	Collection Frequency
Temperature Conductivity Dissolved Oxygen	At least every 30 minutes	Telemetered or Logged
Nutrients (phosphorus and nitrogen) and chlorophyll a (µg/L)	Sampled once during a dredging campaign	
Total and dissolved metals (µg/L)		

[1] For the purposes of this table "telemetered" means the delivering of the monitoring data electronically to LPC as the data is recorded unless otherwise specified in the table.

Ecological, Seabed level and Physical Shoreline Monitoring Associated with the Offshore Maintenance Disposal Ground

7.16 The consent holder shall monitor the presence and abundance of benthic macrofauna at the five benthic ecological stations labelled DD01, DD02b, DD03, DD13, DD14 and DD15 as marked on Plan CRC172456B.

7.17 The consent holder shall monitor the presence and abundance of sub-tidal flora and fauna at the three sub-tidal ecological stations labelled BP02, BP13 and BP14 as marked on Plan CRC172456B.

7.18 The monitoring surveys required under condition 7.16 and 7.17 shall be carried out between four and six months after a Dredging Campaign. No survey is required if no Dredging Campaign is carried out in a particular year.

7.19 The consent holder shall carry out a bathymetric survey to measure seabed levels annually at and immediately adjacent to the Godley Head and offshore maintenance disposal grounds as marked on Plan CRC172456D attached to and forming part of this consent. The surveys shall be carried out between one and two months after a Dredging Campaign. The bathymetric survey accuracy shall be +/- 0.1m to +/- 0.5m in the vertical and horizontal directions respectively for comparable to every other survey undertaken in the same location. The error for each reading is expected to be in the order of 2-8 cm. No bathymetric survey is required if no Dredging Campaign is carried out in a particular year.

7.20 The frequency of benthic, sub-tidal and bathymetric monitoring required under conditions 7.16, 7.17 and 7.19 may be reduced by the consent holder to five yearly monitoring surveys if condition 7.15 is invoked. The consent holder must notify the Consent Authority that it has done so.

7.21 If condition 7.20 takes effect, then the benthic, sub-tidal and bathymetric survey monitoring required under conditions 7.16, 7.17 and 7.19 shall be completed at the same time as the Lyttelton Harbour monitoring required under conditions 7.3 to 7.8. This may entail an additional monitoring survey to enable it to align with the due date of the Lyttelton Harbour survey.

7.22 The consent holder shall carry out the physical shoreline monitoring at the stations shown on marked on Plan CRC172456E attached to and forming part of this consent. The consent holder shall carry out physical shoreline monitoring at the frequency set out in Table 2, and the methodology and equipment to be used shall be detailed in the EMMP.

Table 2: Type and frequency of physical shoreline monitoring

Shoreline Parameter	Monitoring Frequency
Photo-point monitoring[1]	Annually
Beach profile survey[2]	Annual
Shoreline analysis[3]	Five Yearly

[1] To visually assess beach level change or fine sediment deposition from fixed locations and aspects

[2] To quantify changes in profile geometry and/or location from an established benchmark. Assumes profiles at Bright and Sumner will continue to be monitored at 6-month intervals by the Consent Authority

[3] To determine changes in shoreline position using aerials photographs or satellite imagery

Notes
Survey requirements to achieve beach profile:
- Survey using staff and level, total station or RTK GPS
- Survey during spring low tide, pick up all changes in grade
- Required horizontal accuracy +/- 0.1m, vertical accuracy +/- 0.05m

Reporting

7.23 The CHPT shall provide to the TAG and the Consent Authority at the end of June each year an annual report detailing the monitoring of the disposal of Dredge Spoil at the offshore maintenance disposal ground required

under conditions 7.11 to 7.19 and condition 7.22. The report shall include, but is not limited, to the following:

(a) A summary of the monitoring information from the previous year and any monitoring or equipment issues that occurred during period;

(b) An evaluation of the turbidity data collected during a Dredging Campaign;

(c) A review of any triggers being exceeded during a Dredging Campaign, the adaptive management actions carried out and the results of monitoring after the adaptive management actions have been completed;

(d) An evaluation of the benthic and sub-tidal communities surveyed and whether any adverse effects are attributed to disposal activities;

(e) An evaluation of the changes to the seabed level and to the physical shoreline to confirm they are consistent with the predictions made by the hydrodynamic model.

7.24 The annual reporting requirements under condition 7.23 shall cease if condition 7.15 is invoked. The exception is the photo-point and the beach profile survey set out in Table 2 of condition 7.22. These parameters shall continue to be reported on at the end of June of each year.

7.25 The CHPT shall provide to the TAG and the Consent Authority a report of the five yearly monitoring survey required under conditions 7.3 to 7.8 and the benthic, sub-tidal and bathymetric monitoring survey required under condition 7.20 (if annual reporting has ceased). The report shall be completed within three months of the survey and the report shall:

(a) Describe the sampling methodology and the rationale for the sampling methodology;

(b) Detail the results;

(c) Provide an interpretation of the results in terms of any actual or potential effects of depositing maintenance Dredge Spoil on the benthic and inter-tidal communities surveyed;

(d) An evaluation of the benthic and inter-tidal communities surveyed and whether any adverse effects could be attributed to disposal activities; and

(e) An evaluation of the bathymetric data collected to examine any changes in the seabed and an analysis of the shoreline measurements.

7.26 A copy of the monitoring reports prepared under conditions 7.23 and 7.25 shall be provided to the Tangata Whenua and the ALG.

8 TURBIDITY TRIGGERS

Establishment of turbidity triggers

8.1 The consent holder shall establish turbidity triggers for each of the telemetered turbidity monitoring locations. There shall be three tiers of turbidity triggers, each with an Intensity and Allowable Duration value. The purpose of turbidity triggers is:

(a) To initiate an adaptive management action(s) in the event of a Tier 1, 2 or 3 Exceedance which is detailed in the EMMP as required under condition 6; and

(b) For compliance in the case of an Exceedance of the Tier 3 trigger as set out in conditions 8.5 to 8.10.

8.2 The turbidity triggers shall be established in accordance with the methodology (including the modified-Intensity-Frequency-Duration approach) attached in Appendix 1.

8.3 Upon completion of the baseline monitoring the Intensity component of the turbidity triggers for each telemetered turbidity monitoring location shall be calculated using the baseline turbidity data referred to in condition 7.9 plus the Predicted Dredging Turbidity at that location, using the methodology attached in Appendix 1.

8.4 The consent holder shall provide to the Consent Authority, at least two months prior to commencement of dredging, a written report prepared by a suitably qualified and experienced expert which demonstrates that the turbidity triggers have been established in accordance conditions 8.2 and 8.3.

Compliance of Tier 3 turbidity trigger

8.5 The telemetered turbidity monitoring locations required under condition 7.11 and 7.12 are to be used to determine when there has been a Tier 3 Exceedance.

8.6 The disposal of Dredge Spoil at the offshore maintenance disposal ground shall cease or not occur in the vicinity of a telemetered turbidity monitoring location when there is a Tier 3 Exceedance.

8.7 The disposal of Dredge Spoil at the offshore maintenance disposal ground may only recommence in the vicinity of a telemetered turbidity monitoring location when the Tier 3 Exceedance no longer occurs or alternatively the turbidity reading at the telemetered turbidity monitoring location referred to at condition 8.6 is below the Tier 3 Intensity level identified in the EMMP.

8.8 Notwithstanding condition 8.6, the disposal of Dredge Spoil at the offshore maintenance disposal ground may continue in the vicinity of a telemetered turbidity monitoring location provided that:

(a) The consent holder provides the Consent Authority a written report, within 24 hours of Tier 3 Allowable Exceedance referred to in condition 8.6, which demonstrates that the elevated turbidity is due to an extraordinary natural event and not attributable to the disposal of Dredge Spoil at the offshore maintenance disposal ground; and

(b) If the Consent Authority, acting in its technical capacity, disagrees with the findings of the report the Dredging shall cease at the relevant location(s) and only recommence in accordance with condition 8.7. If the Consent Authority provides no written response after two working days then it is deemed that the Consent Authority agrees with the findings of the report prepared under condition 8.8.1 and the disposal of Dredge Spoil at the offshore maintenance ground may continue.

Advice note: An extraordinary natural event that could cause an Exceedance of the tier-3 trigger defined in the EMMP could include a tsunami, a weather event causing significant flooding, extreme off-shore swells, or a land slip.

8.9 The consent holder shall provide a copy of the report prepared under condition 8.8.1 to the TAG and the PRG and place it on its website.

8.10 The compliance measures at condition 8.5 to 8.9 shall cease if turbidity monitoring ceases in accordance with condition 7.15.

9 CONSENT HOLDER PROJECT TEAM (CHPT)

9.1 The consent holder shall employ or otherwise engage person(s) to manage the project and implement the conditions of this consent, which includes ensuring that all monitoring information is gathered and disseminated is consistent with the EMMP and in compliance with the conditions of this consent.

9.2 To achieve condition 9.1, the consent holder shall establish a CHPT which has the necessary expertise to carry out the following:

(a) Prepare monitoring reports required under conditions 7.10, 7.23 and 7.25 and circulate it to the TAG and the Consent Authority as required;

(b) Assess the monitoring data to ensure it meets requirements and is continually being gathered; and

(c) Ensure that the dredging contractor has access to all monitoring information and that adaptive management actions are being initiated and implemented in a timely manner.

10 TECHNICAL ADVISORY GROUP (TAG)

10.1 The consent holder shall establish, at its own cost, a TAG, which is to:

(a) Review the Draft EMMP and DMP and provide technical advice to the CHPT as to whether these plans are fit for purpose; and

(b) Review the monitoring reports and provide technical advice to the CHPT on whether the monitoring programmes required under condition 7 are fit for purpose.

10.2 The consent holder shall establish a TAG at least three months prior to the commencement of the first Dredging Campaign.

10.3 The TAG shall only meet to examine and provide technical advice on the five yearly survey report prepared under condition 7.25 if condition 7.15 is invoked.

10.4 The TAG shall comprise no more than 12 members as detailed below.

Tangata Whenua

10.5 The consent holder shall offer Tangata Whenua the opportunity to have up to three members consisting of the following expertise:

(a) A person knowledgeable and reputable with regard to mahinga kai;

(b) A suitably qualified and experienced specialist in marine ecology and/or water quality, including turbidity; and

(c) A person knowledgeable and reputable with regard to tikanga Maori.

Marine Farm Technical Representative

10.6 The consent holder shall offer the opportunity to have up to two technical representatives of the local Authorised Marine Farms consisting of the following expertise:

(a) A suitably qualified person that has direct experience in operating a marine farm and is currently managing or operating an Authorised Marine Farm in the vicinity of the project;

(b) A suitably qualified person, experienced in assessing environmental effects of or on aquaculture activities or one of the disciplines referred to in condition 10.7.

Consent Holder

10.7 The consent holder may have up to seven members consisting of the following expertise:

(a) A suitably qualified and experienced specialist in marine ecology;

(b) A suitably qualified and experienced specialist in aquaculture;

(c) A suitably qualified and experienced specialist in monitoring the marine environment;

(d) A suitably qualified and experienced specialist in hydrodynamic modelling;

(e) A suitably qualified statistician having experience in natural resource management; and

(f) No more than two other members of the CHPT.

10.8 The TAG shall:

(a) Review and provide initial technical advice on the DMP and the EMMP;

(b) Review the annual monitoring report prepared by the CHPT and meet to discuss the report and where necessary provide advice to the CHPT in writing on whether the monitoring programme detailed in the EMMP requires amendment (including the location of monitoring stations);

(c) Review any exceedances of the turbidity triggers contained in the EMMP and where necessary provide written advice to the CHPT on whether the monitoring programme detailed in the EMMP needs to be amended to better understand whether exceedances are attributed to Dredging or other environment parameters; and

(d) Provide advice on any other technical matters as sought by the Consent Holder.

10.9 The consent holder shall provide any administrative support necessary for the TAG to carry out its functions.

10.10 Where the TAG does not have the expertise in any of the areas on which it is required to report on, it may engage the services of an appropriate expert to advise on a relevant matter to the TAG.

11 AQUACULTURE LIAISON GROUP (ALG)

11.1 Not less than three months prior to the first Dredging Campaign, the consent holder shall invite representatives of the aquaculture industry to participate in an ALG.

11.2 The purposes of the ALG are:

(a) To enable the consent holder and the aquaculture industry to share information relating to the exercise of this consent;

(b) To discuss the monitoring required by this consent, insofar as it relates to the effects of exercising this consent on Authorised Marine Farming Activities, including but not limited to the matters covered in conditions 6.3.1, 6.10,4; 10.8.2 and 10.8.3; and

(c) To ensure that any adverse effects on Authorised Marine Farming Activities are avoided or remedied.

11.3 Invitations to participate in the ALG shall be extended to:

(a) Sanford Limited; and

(b) Authorised Marine Farmers from Northern Banks Peninsula.

11.4 Sanford shall be entitled to appoint one representative to the ALG.

11.5 The Authorised Marine Farmers from Northern Banks Peninsula shall be entitled to appoint three representatives to the ALG.

11.6 The consent holder shall be entitled to appoint up to three representatives to the ALG.

11.7 Once established, the consent holder shall offer to hold meetings of the ALG at least once prior to the first Dredging Campaign and thereafter within two months of the completion of the annual monitoring report required under condition 7.23.

11.8 The costs of participation in the ALG shall lie where they fall, except that all administration costs will be the responsibility of the consent holder.

11.9 The consent holder shall provide no less than two weeks' notice of all ALG meetings and shall keep minutes of these meetings and distribute them within five working days.

11.10 The consent holder shall ensure that the ALG is given an opportunity to provide input into the preparation of the management plans required under conditions 4, 5 and 6. Any written recommendations from the aquaculture representatives on the ALG that are not included in the final management plans shall be provided to the Consent Authority at the same time as the plan is lodged under conditions 4.2, 5.2 and 6.2.

12 WEBSITE OBLIGATIONS

12.1 The consent holder shall maintain a website that is accessible to, and readily usable by, the public during each Dredging Campaign.

12.2 The website shall include but not be limited to the following information:

(a) A summary of real-time data collected from the telemetered stations required under conditions 7.11 to 7.14 of this consent;

(b) Annual monitoring reports prepared under condition 7.23 of this consent;

(c) Any Tier 3 turbidity trigger report prepared under condition 8.12 of this consent;

(d) The DMP and the EMMP or amendments thereof; and

(e) All written reports and reviews prepared by the TAG under condition 10.

12.3 The consent holder may elect to cease the website if condition 7.15 is invoked.

13 COMPLAINTS

13.1 A record of complaints relating to any activity associated with Dredging shall be maintained. Each record, where practicable, shall include:

(a) The location of the reported nuisance or effect;

(b) The date and time of the complaint;

(c) A description of the weather conditions at the time of complaint, if relevant;

(d) Any possible cause of the nuisance or effect; and

(e) Any management actions undertaken to address the cause of the complaint; and the name of complainant, if offered.

13.2 The record of complaints shall be provided to the Consent Authority Manager every year or on request.

13.3 An aggregated summary of the complaints shall be incorporated into the annual monitoring report prepared in accordance with condition 7.23.

Statistical methodology outline – Development of Intensity component of Turbidity Triggers

The below is a summary of the methodology set out in the Environmetrics Australia Report: *Statistical Considerations Associated with the Establishment of Turbidity Triggers: Candidate Methodologies for Large Scale Dredging Projects dated 11 May 2017*

Step 1: Raw data collected by turbidity monitoring stations and sent via telemetry to data warehouse facility.

Step 2: Raw data undergoes preliminary inspection and quality assurance using a combination of both manual and automated processing tools to produce *functionally-assured (F-qaqc)* data.

The purpose of the *F-qaqc* step is to check the consistency and integrity of the data obtained from the monitoring instruments and, where appropriate, to take remedial action. These activities include, but are not limited to:

- Flagging and if necessary, removing readings obtained when equipment was known to be faulty, unreliable, or unserviceable;
- Flagging, but **not** removing readings obtained during adverse weather or oceanographic conditions;
- In the case of dual-instrument deployments, aggregating readings in accordance with agreed protocols;
- Implementing agreed protocols in the case of instrument failure for a dual-instrument deployment.

Step 3: Functionally-assured data then is subjected to rigorous analysis using a variety of statistical procedures to produce *statistically assured data*. Activities within this step include:

1. Identify extreme and unusual data in terms of their *statistical* properties and address as required;
2. Use statistical data imputation techniques in accordance with agreed protocols to overcome problems created by blocks of missing data;
3. Apply the Kolmogorov-Zurbenko (KZ) filter, in accordance with agreed protocols, to attenuate the influence of extreme, transient observations; and

Step 4: Establish TSS-NTU relationship(s)

In order to assimilate the modelled turbidity data (in units of mg/L) with the monitoring data (in NTU) models describing the TSS-NTU relationship need to be established. This involves:

1. Using the complete baseline data record of depth-profiling data at all sites to establish the relationship between sub-surface total suspended sediment concentrations (in mg/L) and contemporaneous measurements of NTU;
2. Additional statistical analysis to establish whether significant spatial variations in the empirical TSS-NTU relationship are evident. If this is the case, *separate* (site-specific) TSS-NTU

models will be used in step 5 below; if not – a single 'omnibus' TSS-NTU model will be used in step 5 below.

Step 5: Convert the modelled data to NTU and combine with measured baseline

1. The TSS-NTU relationship(s) from step 4 will be applied to the modelled TSS concentrations (for an indicative year for the harbour model and for 10 years for offshore model) at each monitoring location to convert predicted TSS concentrations into NTU. At each monitoring site, the timestamp on the modelled output will be used to match a converted TSS value with the measured turbidity obtained at the same day, month, and hour during the baseline monitoring campaign;
2. The converted TSS and baseline NTU values obtained at step 5.1 will be added together to obtain a time-series (annual or longer) of ***total turbidity*** in NTU at each monitoring location;
3. The ***total turbidity*** data obtained at step 5.2 will be used as the basis for determining trigger values for each monitoring location.

Step 6: Calculate the *Intensity* parameters for each site for all three tiers

1. Using the *total turbidity* data at each monitoring location, calculate the Intensity (NTU) for each tier as the relevant percentile in Table 1 of the data obtained in step 5.3

Table 1

Turbidity Trigger	Intensity level $(1-\alpha)$	Nominal Intensity Trigger	Intensity (NTU)	Allowable duration of exceedance (hours) per rolling 30 day period
Tier 1	0.8	$Y_{(1-\alpha)}^{(1)}$	$I_{(1-\alpha)}^{(1)}$	144
Tier 2	0.95	$Y_{(1-\alpha)}^{(2)}$	$I_{(1-\alpha)}^{(2)}$	36
Tier 3	0.99	$Y_{(1-\alpha)}^{(3)}$	$I_{(1-\alpha)}^{(3)}$	7.2

2. For a chosen intensity level $(1-\alpha)$ determine the nominal intensity triggers, $Y_{(1-\alpha)}^{(i)}$, $i=1,2,3$;
3. For a nominal intensity trigger $Y_{(1-\alpha)}^{(i)}$ determine the corresponding upper limit $I_{(1-\alpha)}^{(i)}$ such that the probability that the $(1-\alpha)$ percentile of a sample of *n* filtered turbidity readings (obtained at the end of step 3) exceeding $I_{(1-\alpha)}^{(i)}$ is no more than 1% The determination of $I_{(1-\alpha)}^{(i)}$ shall be based on part (c) of Theorem 7.1 in DasGupta (2008) . The upper limits $\left\{ I_{(1-\alpha)}^{(i)}, i=1,2,3 \right\}$ so determined are referred to as *'intensity'* and form the basis of all monitoring and compliance activities.