
RESOURCE CONSENT CRC172522

Pursuant to Section 104 of the Resource Management Act 1991

The Canterbury Regional Council (known as Environment Canterbury)

GRANTS TO:	Lyttelton Port Company Limited
A COASTAL PERMIT (S12):	<ol style="list-style-type: none">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; and3. To discharge contaminants (seabed material and water) from a ship into water associated with channel deepening as described in CRC172455.
COMMENCEMENT DATE:	06 Mar 2018
EXPIRY DATE:	06 Mar 2043
LOCATION:	Lyttelton Harbour and associated offshore areas, Lyttelton

SUBJECT TO THE FOLLOWING CONDITIONS:

Definitions

0 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 and 2 or Tier 3 Compliance Level 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 Compliance Level: 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 Compliance Level: 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;

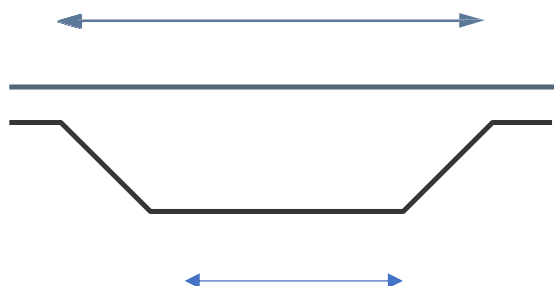
“NTU” means nephelometric turbidity unit;

“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.

Location, Volume and Staging

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- 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.

Administration

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- 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, setting of more stringent 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 8 years after the commencement of the consent.

Notification and Records

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- 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.

Dredge Management Plan (DMP)

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- 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 At least two months prior to the commencement of the second and any subsequent Dredging Stages, the consent holder shall review the DMP and incorporate findings from any monitoring required by these conditions, including the assurance monitoring required under Condition 7.11 and 7.12. The review shall be provided in writing to the Consent Authority and Tangata Whenua and shall identify where any changes to the requirements are required in response to the monitoring findings.
- 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 number and types of dredges 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 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;
 - 4.4.7 A description of measures to manage any conflicts between the Dredging program and organised sporting events in Lyttelton Harbour/Whakaraupo;
 - 4.4.8 A description of a turbulence reducing (green or environmental) valve to be incorporated with the overflow system;
 - 4.4.9 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
 - 4.4.10 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.

- 4.5 A suitably qualified and experienced person in operating a dredge shall review and be involved in the preparation of the DMP.
- 4.6 The Consent Holder shall, on request from the Consent Authority Manager, provide evidence of the processes that are used to ensure that the dredging contractor and all staff are familiar with the conditions contained in this Consent and the Consent Holder's EMMP, and responsibilities to ensure compliance.

Certification of DMP

- 4.7 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.
- 4.8 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.
- 4.9 A copy of the DMP and all amended DMP's shall be provided to Tangata Whenua, the TAG and the ALG immediately following certification.

Marine Mammal Management Plan (MMMP)

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- 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 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.

Biosecurity Management Plan (BMP)

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- 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.

Environmental Monitoring and Management Plan (EMMP)

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- 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 or Tier 3 Compliance Level;

- 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 including the DMP and the linkages and cross references to those 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 and Tier 3 Compliance Level that are to be specified under condition 7.8;
 - 7.5.2 Assess whether a turbidity event is determined to be an extraordinary natural event; and
 - 7.5.3 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 Tier 1 and Tier 2 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 two tiers

- of turbidity triggers and one Tier 3 Compliance Level;
- 7.8.2 Details of how the Tier 1, and Tier 2 turbidity triggers and Tier 3 Compliance Level are determined using the methodology referred to in condition 9.3.
 - 7.8.3 Setting out the Intensity values for Tier 1, and Tier 2 turbidity triggers and Tier 3 Compliance Level 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, or Tier 2 turbidity trigger or Tier 3 Compliance Level is exceeded.
- 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; and
 - 7.9.2 Investigating whether the exceedance of the trigger is caused by Dredging; and
 - 7.9.3 Where necessary increasing monitoring effort to better understand the characteristics of the turbidity causing an Exceedance, such as carrying out manual turbidity measurements in the vicinity of the monitoring station;
- 7.10 The EMMP shall also include a suite of management response measures that may be undertaken in response to an Exceedance of a turbidity trigger, including:
- 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 cessation of Dredging in the vicinity of a telemetered turbidity monitoring station.

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 to determine whether Dredging-related suspended solids are adversely affecting or 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 be carried out prior to, during and after Dredging Stage;
- 7.12.2 Water quality monitoring which is to be carried out before, during and after Dredging;
- 7.12.3 Sediment and Dredge Spoil quality monitoring;
- 7.12.4 Physical beach shore monitoring prior to, during and after each Dredging stage;
- 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.

7.15 Where the assurance monitoring required under Condition 7.12 has identified changes to sub-tidal, intertidal and/or benthic ecological or the physical beach shore that may be attributable to Dredging, the Consent Holder shall, in consultation with TAG, undertake a full review of the DMP, with a specific focus of the items listed in Condition 4.4. The revised DMP shall contain a response to comments received from the TAG.

Note: Conditions 4.5 - 4.9 shall apply to this review.

Certification of EMMP

7.16 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.

7.17 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.

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

Monitoring

- 8.1 The consent holder shall undertake a monitoring and reporting programme in accordance with conditions 8.2 to 8.25.
- 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 seven or more years after the completion of the final quarterly monitoring report prepared under condition 8.17 the CHPT shall prepare:
- 8.19.1 After consultation with the TAG and ALG, a written report that evaluates whether any further pre-stage baseline monitoring is required; and
 - 8.19.2 A monitoring programme where further baseline monitoring is considered necessary.
- 8.20 The report prepared under condition 8.19 shall be provided to the PRG, Tangata Whenua and the Consent Authority in sufficient time to enable monitoring to be undertaken before the next Dredging Stage.
- 8.21 The Consent Holder shall provide the PRG the opportunity to make comments on the report prepared under Condition 8.19, which may include a request to reject, modify or accept the monitoring programme contained in the report.
- 8.22 The Consent Holder shall give the PRG at least one month's prior notice of the report pending under Condition 8.19 and shall give it one month to provide its comments upon receipt of that report. The Consent Holder shall provide a copy of the PRG's comments to the CHPT, Tangata Whenua and the Consent Authority.

- 8.23 If the PRG recommends to reject or modify the monitoring programme prepared by the consent holder under Condition 8.19, then the consent holder shall either update the monitoring programme; or, where PRG recommendations have not been accepted, state why not.
- 8.24 If the Consent Authority, acting in its technical capacity, disagrees with the findings of the report prepared under condition 8.19 and 8.23, the Consent Authority shall set out in a report to the consent holder within one month of receiving the report:
- 8.24.1 Details of the reasons why it disagrees; and
 - 8.24.2 An alternative baseline monitoring period provided that the baseline monitoring period specified does not exceed a period of 12 months.
- 8.25 The consent holder shall undertake the monitoring programme prepared under condition 8.19 with any changes under Conditions 8.24

Turbidity Triggers and Tier 3 Compliance Level

9 9A: Establishment of turbidity triggers and Tier 3 Compliance Level:

- 9.1 The consent holder shall establish turbidity triggers and a Tier 3 Compliance Level for each of the telemetered turbidity monitoring locations. There shall be two tiers of turbidity triggers and one Tier 3 Compliance Level, each with an Intensity and Allowable Duration value.
- 9.2 The purpose of turbidity triggers is to:
- 9.2.1 Initiate an adaptive management action(s) in the event of a Tier 1, or 2 or 3 Exceedance which is detailed in the EMMP as required under condition 7.7;
 - 9.2.2 Initiate requirements for compliance in the case of an Exceedance of the Tier 3 Compliance Level as set out in conditions 9.6 to 9.9.
- 9.3 Turbidity triggers and Tier 3 Compliance Levels shall be established in accordance with the methodology (including the modified-Intensity-Frequency-Duration approach) attached in **Appendix 2**.
- 9.4 Upon completion of the baseline monitoring, the Intensity component of the turbidity triggers and Tier 3 Compliance Level 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**.
- 9.5 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 and Tier 3 Compliance Level have been established in accordance conditions 9.2 and 9.3.

- 9.5A The report prepared under condition 9.5 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.

9B: Tier 3 Compliance Levels and Exceedance Events

- 9.6 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 Compliance Level Exceedance.

- 9.7 If a monitoring station records an Exceedance of the Tier 3 intensity value for more than 7.2 hours, Dredging must cease in the vicinity of that monitoring station and only recommence in the following circumstances:

- 9.7.1 The number of Tier 3 "exceedance hours" has fallen below the 7.2 hours available at that station over a 30-day rolling period, or
- 9.7.2 The turbidity recorded at that station is less than the Tier 3 NTU intensity value calculated for that station; or
- 9.7.3 The exceedance is due to an extraordinary natural event as detailed in condition 9.8.

Advice Note: The turbidity information at each monitoring station can be viewed on the Consent Holders Web-site (refer to Condition 14.2.4).

- 9.7A The Consent Holder shall ensure that methods for managing and achieving compliance with the requirements of Condition 9.7 shall be set out in the DMP.
- 9.8 Notwithstanding condition 9.7, 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 Compliance Level Exceedance referred to in condition 9.7 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 9.7.1 and 9.7.2. 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 should be a significant and self-evident natural event that has clearly caused an Exceedance of the Tier 3 Compliance Level at one or more of the turbidity monitoring stations. The high-concentration turbidity plumes would have been generated from 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.

Consent Holder Project Team (CHPT)

10

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.

Technical Advisory Group (TAG)

11

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 its functions.
- 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.

Aquaculture Liaison Group (ALG)

12

- 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.

Peer Review Group (PRG)

13

- 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:
 - 1. marine ecology, including aquaculture and other seafood resources;
 - 2. coastal processes;
 - 3. 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:
 - 13.6.3.1 Baseline monitoring report prepared under condition 8.13;
 - 13.6.3.2 The quarterly monitoring reports prepared under condition 8.16;
 - 13.6.3.3 The Dredging Stage Monitoring Report prepared under condition 8.18; and
 - 13.6.3.4 Receive any report on a Tier 3 Compliance Level Exceedance prepared under condition 9.8.1.
 - 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.

Website Obligations

14 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 Real-time data in pictorial form showing the number of hours in a rolling 30-day period during which the Turbidity level in (NTU) for each Tier at each telemetered turbidity monitoring location has been exceeded;

14.2.5 A record of all Tier 3 Compliance Level Exceedances that are correlated with identification of any extraordinary natural events;

14.2.6 Any Tier 3 Compliance Level Exceedance report prepared under Condition 9.8.1 of this consent;

14.2.7 The DMP, MMMP, BMP and the EMMP and any amendments thereof; and

14.2.8 All written reports and reviews prepared by the TAG or PRG under conditions 11 and 13 respectively.

Complaints

15 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.

Accidental Discovery Protocol

16

- 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 Hapu o Ngati 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 Hapu o Ngati Wheke if the site is of Maori origin and the action taken on the archaeological material discovered.

Whakaraupo/Lyttelton Harbour Mahinga Kai Enhancement

17

- 17.1 The Consent Holder shall provide funding to mitigate the adverse effects on the cultural and spiritual values of Whakaraupo/Lyttelton Harbour from the dredging and disposal which have not been avoided. The funding shall be made to Te Hapu o Ngati Wheke to restore and improve mahinga kai to Whakaraupo.
- 17.2 The Consent Holder shall pay to Te Hapu o Ngati Wheke the following funds:

- a. An initial payment of \$50,000 within one month of the date of the commencement of this consent; and
- b. Twenty-four (24) annual payments of \$25,000 on or before the annual anniversary of the date of the commencement of this consent, the first payment being on the first anniversary of the date of commencement of this consent.

17.3 The obligations on the Consent Holder set out in this condition shall continue for 25 years irrespective of whether the consent lapses or is surrendered, and the Consent Holder shall not surrender the obligations set out in this condition.

Koukourarata/Port Levy Mahinga Kai Enhancement

18

18.1 The Consent Holder shall provide funding to mitigate the adverse effects on the cultural and spiritual values of Koukourarata/Port Levy from the dredging and disposal, which have not been avoided. The funding shall be made to Te Runanga o Koukourarata to restore and improve mahinga kai for Koukourarata/Port Levy.

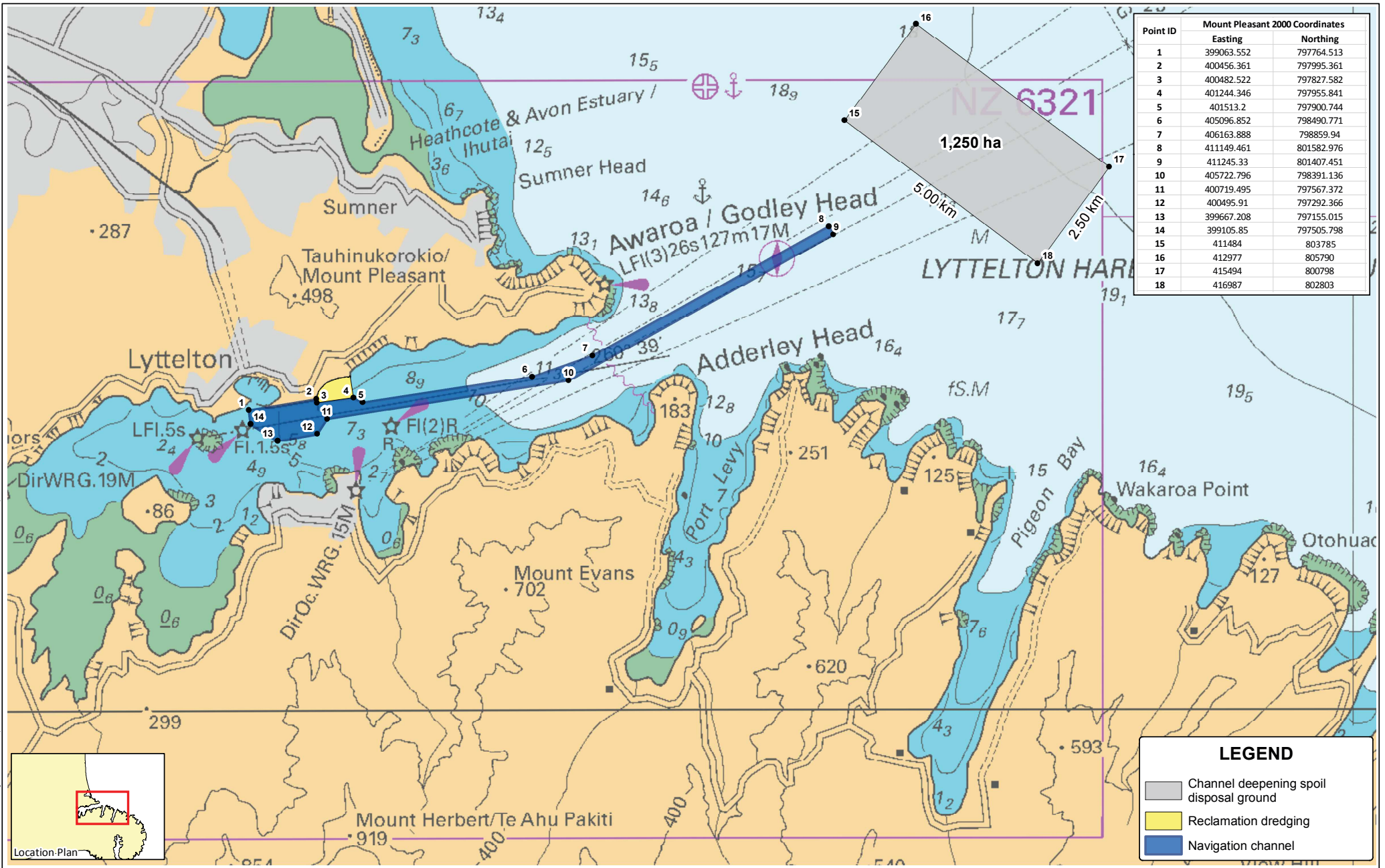
18.2 The Consent Holder shall pay to Te Runanga o Koukourarata the following funds:

- a. An initial payment of \$50,000 within one month of the date of the commencement of this consent; and
- b. Twenty-four (24) annual payments of \$25,000 on or before the annual anniversary of the date of the commencement of this consent, the first payment being on the first anniversary of the date of the commencement of this consent.

18.3 The obligations on the Consent Holder set out in this condition shall continue for 25 years irrespective of whether the consent lapses or is surrendered, and the Consent Holder shall not surrender the obligations set out in this condition.

Issued at Christchurch on 24 May 2018

Canterbury Regional Council



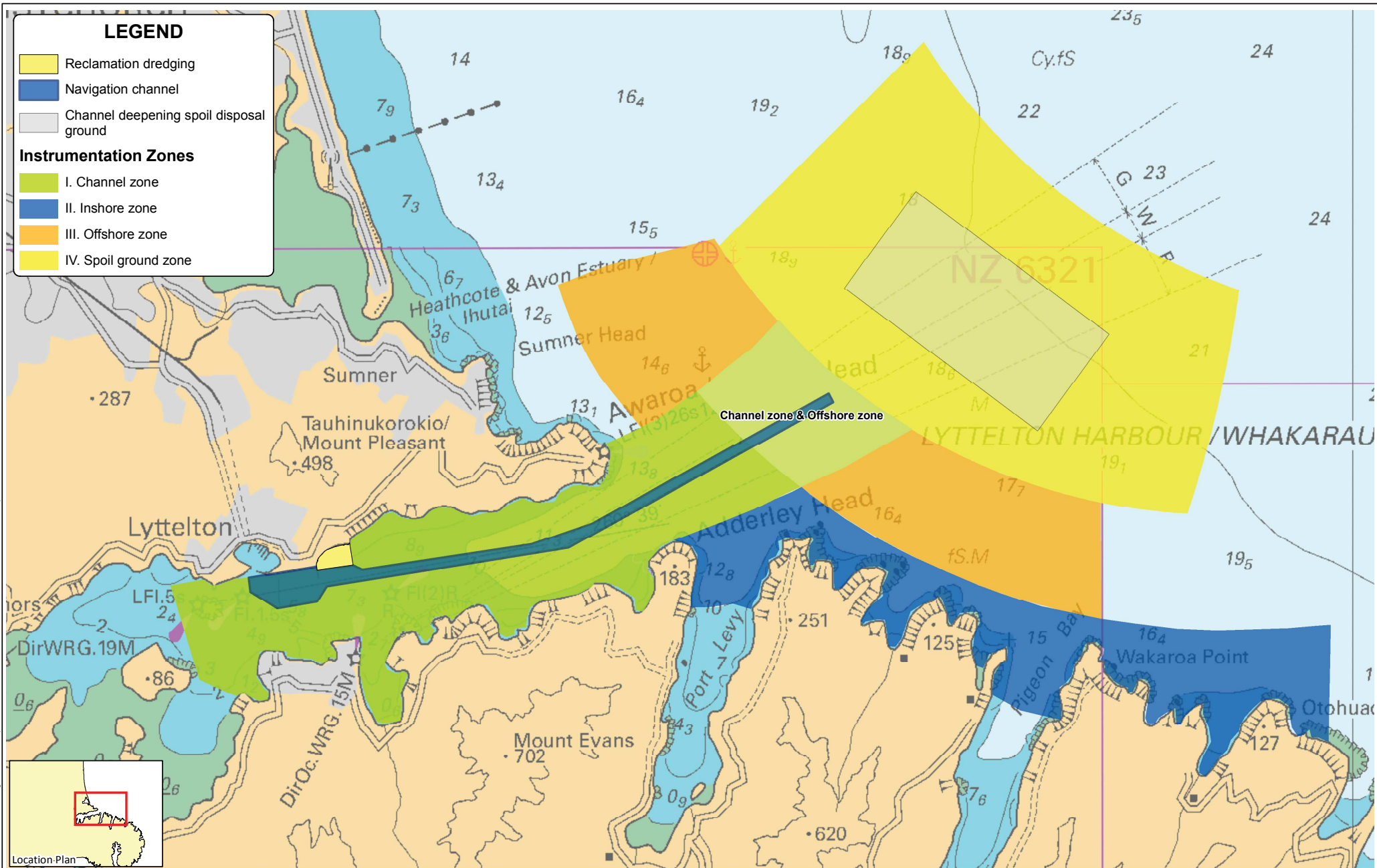
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LEGEND

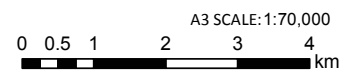
Channel deepening spoil disposal ground

Reclamation dredging

Navigation channel



Notes: Note 1. Chart NZ 63 Kaikoura Peninsula to Banks Peninsula sourced CC-BY Land Information New Zealand.
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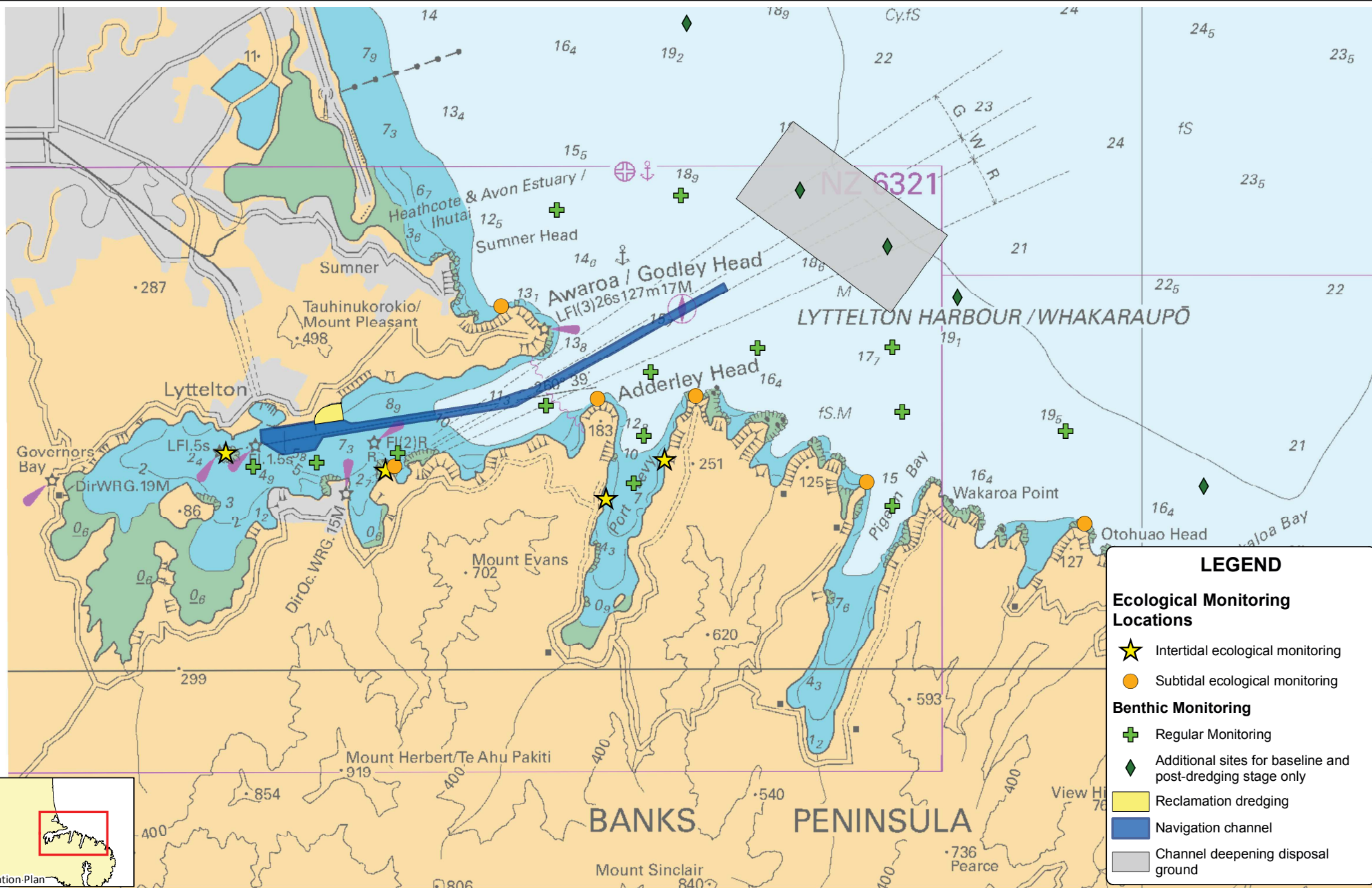
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PROJECT No.	53312.0090	

Plan CRC172455B

FIGURE No.

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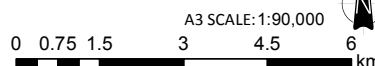
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Note 4. Location of monitoring points is currently indicative, intended for illustrative use only.

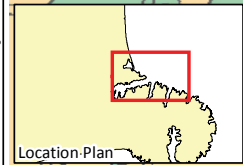
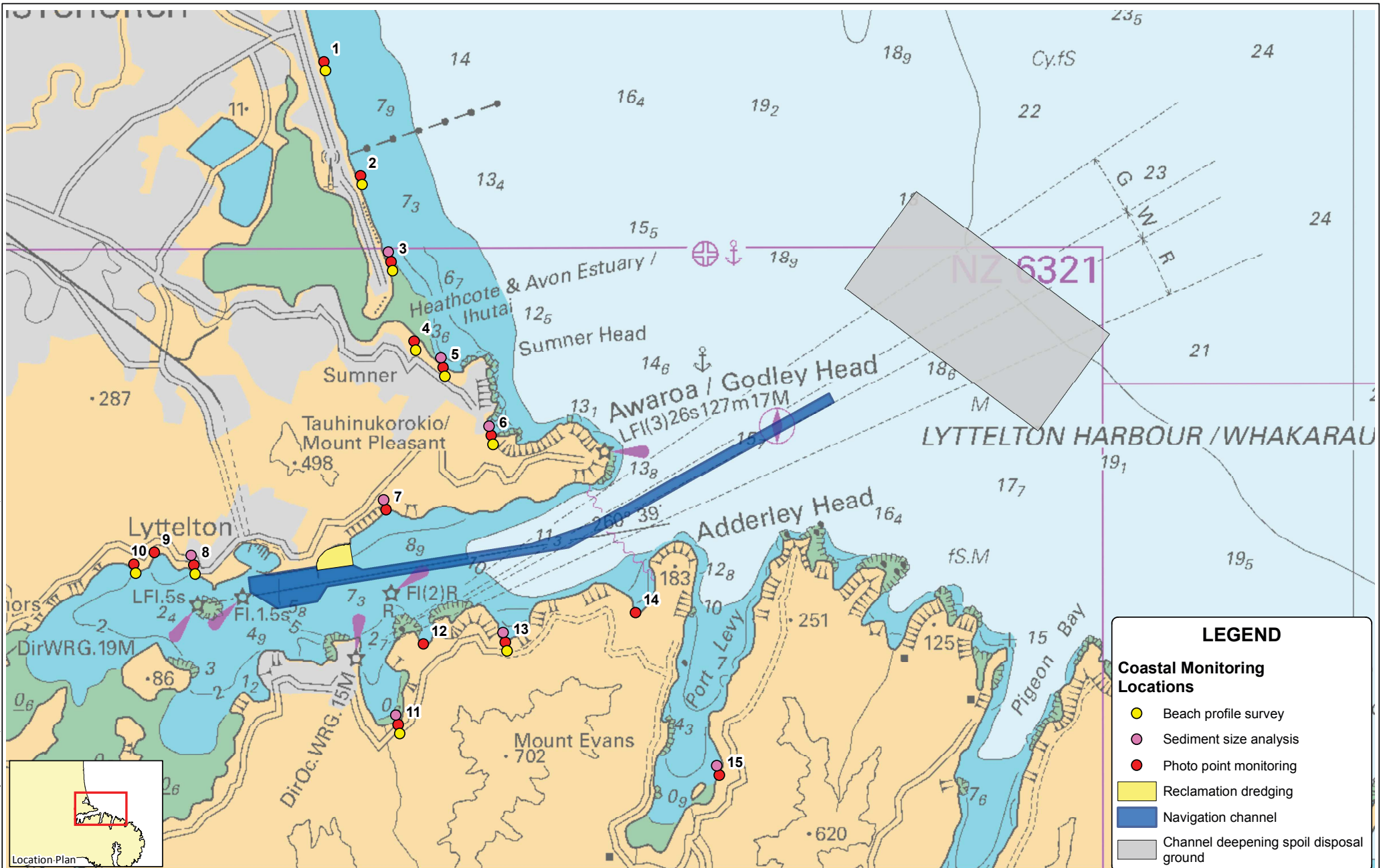


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PROJECT No.	53312.0090	

Plan CRC172455C

FIGURE No.	Rev.
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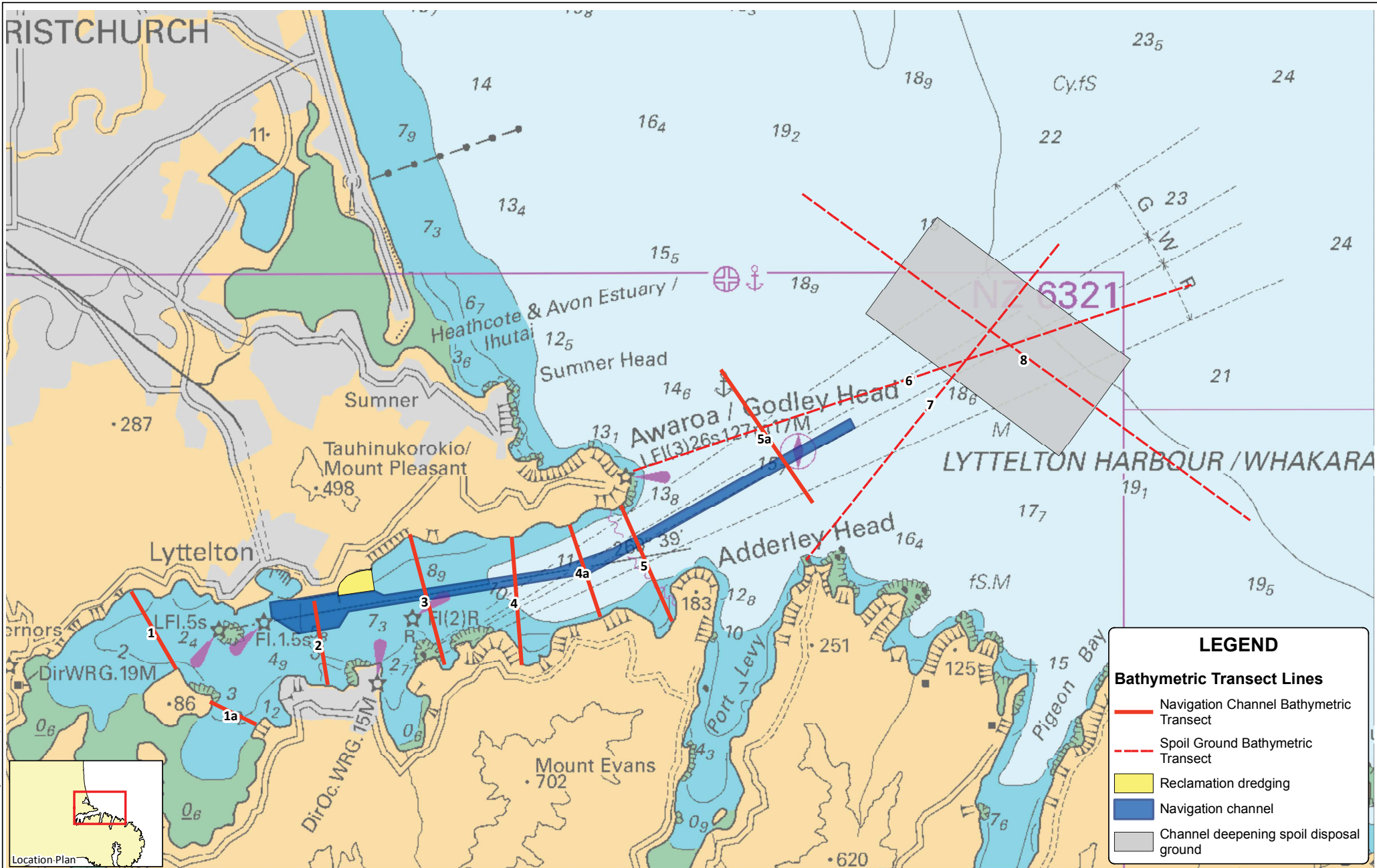
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PROJECT No.		
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FIGURE No. _____ Rev. _____



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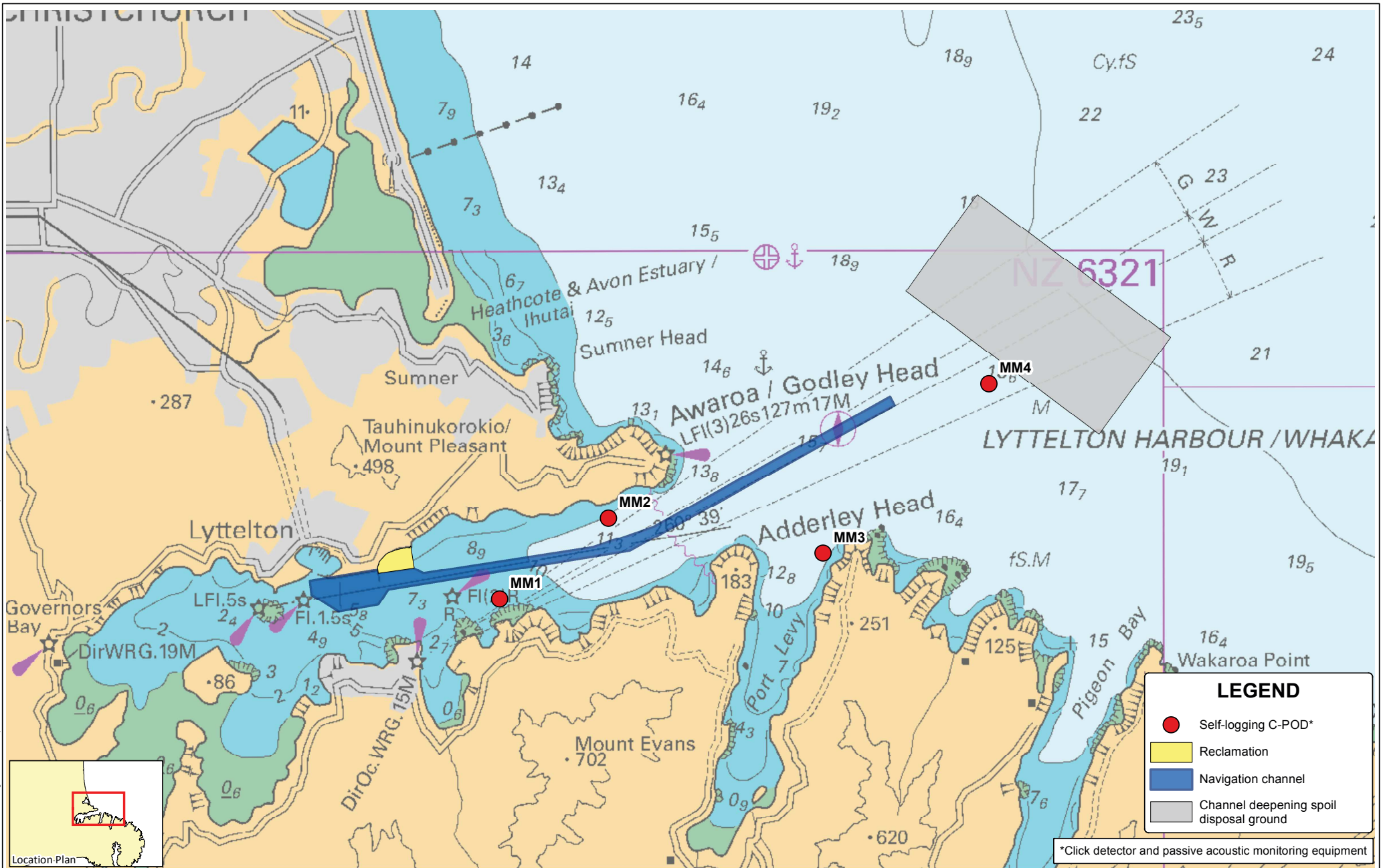


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FIGURE No. _____ Rev. _____



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FIGURE No.

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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/m²/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	
	<ul style="list-style-type: none">• 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 <ul style="list-style-type: none"> • 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-monthly		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 $\{I_{(1-\alpha)}^{(i)}, i = 1, 2, 3\}$ so determined are referred to as ‘*intensity*’ and form the basis of all monitoring and compliance activities.