



Port Otago Ltd.
Te Rauone Beach - Rock Groynes and Sand Re-
nourishment
Resource Consent Application (Revised)

April 2020

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1. Form 9

APPLICATION FOR RESOURCE CONSENT UNDER SECTION 88 OF THE RESOURCE MANAGEMENT ACT 1991

TO: Otago Regional Council and Dunedin City Council

Port Otago Limited, apply for the following type(s) of resource consent:

- Coastal permit for occupation of the coastal marine area
- Coastal permit for erection of a structure in the coastal marine area
- Coastal permit for disturbance of the foreshore and seabed
- Coastal permit for deposition of sand in the coastal marine area
- Coastal permit to discharge water and sand to the coastal marine area
- District land use consent for earthworks – large scale and within 20m of mean high water springs
- District land use for the removal of pohuehue vineland vegetation which is habitat for the southern grass skink, a species listed in Appendix 10A.2 of the 2GP

1. **THE NAMES AND ADDRESSES** of the owners and occupiers (other than the applicant) of any land to which the application relates are as follows:

Owners/Occupiers: Dunedin City Council

2. **THE LOCATION** to which this application relates is:

Physical Location: Te Rauone Beach, 935 Harington Point Road, Harington Point, Dunedin

Legal Description: Lot 1 Deposited Plan 6468
Lot 2 Deposited Plan 375006
Lot 2 Deposited Plan 18598

A copy of the Certificate of Title is attached as Appendix A.

3. **A DESCRIPTION** of the activity to which the application relates is:

Please refer to Section 4 of this application for a description of the activity.

4. **A DESCRIPTION** of other activities that are part of the proposal to which the activity relates is:

Construction of three rock groynes and the deposition of sand for the purpose of beach renourishment at Te Rauone Beach, Dunedin.

5. **THE FOLLOWING ADDITIONAL RESOURCE CONSENTS** are required for the proposed activity:

No other resource consents are required.

6. **AN ASSESSMENT** of any effects that the proposed activities may have on the environment in accordance with the fourth schedule (specifically clauses 6 and 7) to the Resource Management Act 1991 is attached in such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

7. **AN ASSESSMENT** of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991 is attached.

8. **AN ASSESSMENT** of the activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act is attached.

9. **ATTACHED** is the following further information that is required to be included in this application by the district plan, the regional plan, the Resource Management Act 1991, or any regulations made under that Act:

Detailed Design Report

Traffic Assessment

Ecological Impact Assessment

Coastal Processes Assessment

pp



Signed on behalf of applicant

Andy Pullar

Dated this 3 April 2020.

ADDRESS FOR SERVICE:

Port Otago Limited
15 Beach Street
Port Chalmers 9023

Attention: **Andy Pullar**

Ph: +64 21 2298 777

Email: apullar@portotago.co.nz

2. Introduction

2.1 Purpose of this report

This Assessment of Effects on the Environment Report (AEE) has been produced to support a resource consent application by Port Otago Ltd (the applicant) to Otago Regional Council (ORC) and Dunedin City Council (DCC). The application relates to the proposed construction of rock groynes and the deposition of sand to rehabilitate Te Rauone Beach in Otago Harbour which has been subject to significant erosion.

The report sets out the information required, along with various assessments to demonstrate that the project meets the tests set out in the Resource Management Act 1991 (RMA) and the relevant planning instruments, including:

- A description of the proposed activity;
- Identification of the consents required;
- An Assessment of Environmental Effects in accordance with the requirements of Section 88 and the 4th Schedule of the Act;
- An assessment of the relevant, rules, policy and other statutory planning instruments with respect to this application; and
- Other information that is required by the appropriate Rule or Plan.

This report has been prepared in accordance with the requirements of section 88 of the RMA and its amendments. It provides the information necessary for a full understanding of the proposal and any actual or potential effects that the activity may have on the environment and is in such detail that corresponds with the scale and significance of the activity.

2.2 Revised edition

This report is a revised edition to the AEE that was submitted to ORC and DCC on 9 December 2019. Changes have been made following requests for further information pursuant to section 92 of the RMA. This report and the attachments within supersede any previous versions.

2.3 Scope and limitations

This report has been prepared for the benefit of Port Otago Ltd. for the purpose agreed between GHD and Port Otago Ltd. as set out in Section 2.1 of this report. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person. This disclaimer shall apply notwithstanding that the report may be made available to other persons for a permission or approval or to fulfil a legal requirement.

3. Site description

3.1 Background

Te Rauone Beach has a history of sand loss and realignment over the past century, with the northern end retreating landwards while the southern end has built seaward. This appears to be associated with changes to the harbour entrance in the 19th century and the resulting changes to sand supply and the wave climate at the beach.

Te Rauone Beach is subject to wave attack from three types of wave environments. The first is from longer period swell waves and shorter period wind waves penetrating into Otago Harbour through the entrance channel. These waves erode sand from the beach and in conjunction with currents, transport the sand southward along the beach towards Wellers Rock. The second, and most dominant, is from short period waves generated from south-westerly winds travelling along and across the harbour. The waves can be up to 0.5m high, and result in erosion of sand from the dunes and beach, transporting that sand offshore into deeper water where it deposits into the dredged shipping channel. This occurs particularly over the top half of the tidal cycle. The third type of waves are generated by vessel traffic in the harbour. These waves include a surge component that can in some instances take sand offshore from the dunes during high tide, and potentially transport sand along the shore.

The erosion along the unprotected north end face of the Te Rauone Beach Reserve is the most dramatic, while protective works by property owners to the north and south of the reserve have had various degrees of success. It has been shown that these walls have also contributed to erosion of the beach over time.

The proposal to construct groynes and undertake sand replenishment is the chosen option to mitigate the erosion issues at Te Rauone Beach. The solution has been developed over a 10+ year period with significant involvement from the Te Rauone Beach Coast Care Committee (TRBCCC) as well as professional coastal engineering design advice provided by Beca, Dr Martin Single and Port Otago Ltd.

Relevant to the project is the intentions of the DCC to upgrade the Te Rauone Beach Reserve which forms the land behind the proposed works area. The reserve upgrade is likely to include carparks and accessways, playground and picnic areas, boardwalks and a maintenance vehicle track (to manage beach access), and dune building and planting landward of the beach. The reserve upgrade, which is presently at an early concept stage does not form part of this application but will need to interface with the proposed beach management works. Temporary construction access for the beach management works (subject to this application) is proposed to be consented through this application and the construction of a proposed boardwalk providing permanent access across the southern groyne will be provided as part of this proposal.

3.2 Community participation

TRBCCC are a community group that were formed in light of the loss of beach and amenity and is made up of residents that live along the coast and specifically around Te Rauone. The aim of the committee is to represent the community in a unified manner, to facilitate project and fund-raising requirements and to ensure the completion of the Te Rauone Beach Rock Groyne / Sand Nourishment Project. TRBCCC have been a vocal community group who are passionate about the reinstatement of Te Rauone Beach which is a valued community asset. Their vision statement includes “to re-instate a safe and accessible beach amenity that can be utilised and enjoyed by all members of our diverse community”. POL has been working closely with TRBCCC to realise the project since 2008. TRBCCC have been active in holding community meetings which have been inclusive and have involved residents of Te Rauone Beach, iwi representatives, the Mayor of Dunedin, elected officials, the wider public, Otago Community Trust, Department of Conservation and the Otago Regional Council.

3.3 Site description

Te Rauone Beach is located on the north eastern end of the Otago Peninsula near the harbour entrance. The proposed works are to be located at the northern end of the beach as illustrated in Figure 1.



Figure 1 Te Rauone Beach – Location Plan

The northern end of Te Rauone Beach is approximately 300 m long. The Te Rauone Beach Reserve is located directly behind the beach and is characterised by open grass areas, pockets of vegetation and trees along with Council facilities and a playground area. Coastal properties are located on the small headlands beyond the northern and southern extent of the reserve which are part of the Harington Point community. A number of these properties have constructed rock revetment structures of their own in an attempt to protect their properties from the coastal erosion occurring.

The foreshore of Te Rauone Beach is a transitional area where accreting sand forms a sandy beachfront at the southern end of the beach (protected by the protruding headland) and the

submerged northern end of the beach where significant erosion is occurring. The middle part of the beach has been adversely affected by a sand deficit due to the current wave environment and associated erosion.

During site visits undertaken in 2010 and late 2019, the remnants of original timber groyne structures (expected to be constructed around the 1890s) were found at Te Rauone Beach in the vicinity of the southernmost proposed groyne. No other findings of archaeological or heritage significance were discovered.

3.4 Zoning

3.4.1 Otago Regional Plan –Coast for Otago

The site falls within a Coastal Protection Area (CPA) of the Otago Harbour as identified in Schedule 2 of the Regional Plan: Coast for Otago (RPC). CPA17 includes the subject site and relates to the following natural features:

- Kai Tahu cultural and spiritual values.
- Estuarine values which include a wading area for migratory birds.
- The intertidal flats are a significant cockle habitat.
- There are seagrass beds in parts of this area.

Also noted in relation to the CPA is the heritage seawall and a registered midden. It can be confirmed that the works will not impact the protected seawalls.

Te Rauone Beach is listed as a Coastal Hazard Area in Schedule 3 of the RPC and highlighted as an area subject to “sandy beach erosion” with the beach, road and property noted as being at risk.

Outstanding natural landscapes as identified in Schedule 3.2 are located within the Otago Harbour, however none are within the proposed works area with the nearest being on the adjacent side of the shipping channel.

3.4.2 Proposed Second Generation Dunedin City District Plan

While predominately occurring within the coastal marine area, some of the proposed beach replenishment works will be located above Mean High Water Springs (MHWS), therefore district plan rules apply.

Under the Proposed Second Generation Dunedin City District Plan (2GP), the landward side of Te Rauone Beach is zoned as ‘Recreation’.

Te Rauone Beach is also located within an ‘Archaeological Alert Layer’, a ‘Native Reserves - Otago Heads (Taiaoroa/Mount Charles)’ Overlay, is a ‘Hazard 3 – Coastal’ site and is subject to two Wahi Tupuna Overlays known as the ‘Ōtākou Harbour’ and Ōtākou Native Reserve.

3.4.3 Operative Dunedin City District Plan

No rules identified as relevant under the 2GP are under appeal and are therefore fully operative. As a result the Operative Dunedin City District Plan has not been considered under this application.

4. Description of the Proposal

4.1 General description of proposal outcomes

In 2016, a key objective to improve the amenity of Te Rauone Beach was developed in collaboration with the TRBCCC: The objective was to:

Provide a beach amenity with a high tide beach of at least 5 m.

The chosen beach management option to achieve this objective includes the construction of three rock groyne structures extending seaward out from Te Rauone Beach and the importation of sand. These works are outlined in greater detail below.

4.2 Physical structures

The rock groynes proposed as part of the beach management scheme are to be constructed in front of the Te Rauone Beach Reserve area. The purpose of the groynes are to maintain the sand imported as part of the beach management scheme and protect the beach from the ongoing coastal erosion experienced. The groynes will extend approximately 70-80 m from the existing shoreline and have a base of around 17.5 m, widening to 23.5 m at the head of each structure. The top of each groyne is proposed to be approximately 4 m, widening to 6 m at the head of each groyne. The batter slope of the groynes will be approximately 1.75 m to 1 m which alters to 2.5 m to 1 m at the head of the groyne.

The groyne crest level at the landward end is 0.5 m above the re-nourished beach profile to provide containment of the material. The crest level at the seaward end of the groynes is set at Mean Sea Level (MSL) to minimise the visual impact of the groynes.

The groynes will be constructed of 0.5 m diameter rocks which will form the armour layer of the structure with smaller rocks (around 0.2 m diameter) forming the core of the structure. Heavy duty geotextile matting will be placed beneath and through the groynes to reduce the movement of sand through the structures. The southern groyne will be constructed without the geotextile to allow some natural migration of sand south.

The northern groyne will connect with the existing rock revetment located at that end of the beach. It is anticipated that localised revetment reconstruction works will be required. The central and southern groynes will be free standing. A boardwalk will be developed around the landward end of the southern groyne to provide better access to the beach at its southern extent. These works are part of this application..

Drawings of the proposed groynes are contained in the Detailed Design Report attached in Appendix B

4.2.1 Existing rock revetment

As described in section 4.2 above, the northern groyne will attach to the southern end of an existing rock revetment structure. The existing rock revetment is located in front of the properties directly north of Te Rauone Beach and was constructed around 1990 to counter the coastal erosion experienced in the area. It was constructed by a local contractor who has used rock between 0.5 m and 1 m in diameter with rock top ups occurring approximately every five years. Consultation with the adjoining land lease holder has confirmed the structure has been successful in countering the erosion of these properties. A letter of approval from the lease holder of the land adjacent to where the groyne will attach is included in Appendix I of this AEE.

Appendix B provides further detail on the engineering of the existing rock revetment structure and how the proposed northern groyne will attach to it. Appendix B also includes an existing sea wall plan (see drawing 3331121-SK-003).

4.3 Beach renourishment

It is proposed that, following the construction of the northern and central groynes, sand will be deposited along the north end of Te Rauone Beach. The deposition area relates to approximately 300 metres of coastline located in front of the Te Rauone Beach Reserve.

The survey undertaken in 2017 estimated that approximately 19,000m³ of sand was required to renourish Te Rauone Beach in the manner illustrated on drawing number 3331121-CA-103 Rev F prepared by Beca, dated 19.04.19 (Appendix A). In order to factor in the erosion that has occurred since this time and further erosion that is expected to arise while the consent applications are being determined before the work can commence, an additional allowance of 7,500m³ – 15,000m³ more or less of sand will likely be required during the initial works period. So the total initial deposition is predicted to be 26,500m³ - 34,000m³, more or less, to be determined by an updated survey, immediately prior to the works being undertaken. The revised volume of sand required will be provided to the ORC and is included as a condition of consent in Section 9 below.

Beach renourishment will likely occur with sand trucked to site to provide the initial sand base (approximately 1,200m³) with the remainder being supplied by dredged sand from Port Otago Ltd's consented dredging of the adjacent shipping channel (Resource Consent 2010.193). The sand proposed to be used for the beach nourishment project will be sourced from the Port Otago Harington Bend claim area as the sand from this source matches the grain size naturally found on Te Rauone Beach.

In the 5-10 years following initial sand deposition, there will be a requirement to maintain and possibly top up the sand on the beach, in order to maintain the new beach profile. While significantly reduced by the proposed works, sand will still migrate from Te Rauone Beach through natural coastal process, storm events and wind. Appendix F, section 3.1 provides further detail on sand migration likely to occur following completion of the proposed works.

Maintenance requirements, the extent and frequency of which will be confirmed using the proposed monitoring and inspections provided within the detailed design report (Appendix B) and offered as a conditions of consent, are expected to include:

- Relocation of sand within each crenulate beach, between the groynes. This may be on a two to five yearly frequency and after significant storm events.
- As determined by beach monitoring, sand may be recycled from the accreting southern end of the beach to the renourished beaches. The objective is to relocate the sand before it has the opportunity to be moved further south to the Wellers rock jetty area. This may be on a two to five yearly frequency and after significant storm events.
- Renourishment of the beaches using sand sourced from Harington Bend or similar. This may be on a five to ten yearly frequency and after significant storm events.
- An average grain size of no less than 0.2mm and less than 2% fines will be used.

Rock groyne maintenance requirements are discussed separately in Appendix B. It is noted that the maintenance of the rock groynes is a permitted activity under Rules 8.5.2.3 and 9.5.3.4 of the RPC.

4.4 Construction methodology

4.4.1 Site establishment

A contractor's site establishment area will be required to prepare for the proposed works. The area will include site offices, plant, materials and staff parking. Access ways will also be developed to allow for personal, machinery and trucks transporting rock and sand to access the site. . The temporary establishment and storage area is expected to be located on the DCC reserve and / or an adjacent landowner's private property. Site offices, plant, materials and staff parking will be located in this

establishment area. Minimal stockpiling of rock is anticipated. The location of these areas including access are shown on the Beca drawing referenced 3331121-SK-002 and attached within Appendix B

During the construction period, access to the beach and foreshore, site establishment area and site access ways will temporarily be restricted, in order to safeguard the public and the contractor's staff. This will be achieved using temporary site fencing and signage. Signage is also shown on the abovementioned drawing and will be designed to comply with 2GP rules.

The temporary accessways are expected to comprise a running course of clean AP65 aggregate (approximately 1500m² area and 300m³ in situ volume) placed over geogrid/geofabric, with minor grading of the sandy backshore at the beach accesses to provide a smooth transition between land and beach (up to 400m² area and 300m³ in situ volume of grading). Disestablishment, including removal of temporary accesses, site offices, plant and any surplus materials and reinstatement of the contractor's site area, will be completed at the end of construction.

4.4.2 Groyne structures

Following establishment of the site, construction of the rock groynes will begin.

Rock transportation

Rock will likely be sourced from Logan Point Quarry near the Dunedin CBD and trucked to Te Rauone Beach via Portobello Road/ Harington Point Road. Approximately 4,200m³ of rock will be transported to the site generating around 325 truck movements. Up to 11 round trips will be undertaken per day which allows for minimal stockpiling of rock to be required on site. Further detail is provide in the Traffic Impact Assessment (see Appendix C)

Groyne construction

The rock groyne construction will first involve the preparation of the beach using an excavator. The excavator will construct the groynes by placing the rocks brought to site by truck. A heavy duty geotextile will be placed underneath and through each groyne to reduce the migration of sand through the groynes as explained in Section 4.2 above. The placement of rock will continue until the desired groyne size and shape is completed.

Land based construction may require the construction of temporary bunds to allow access for the excavator. These bunds will likely be constructed using imported material (e.g. sand) and extend seaward next to the groyne under construction. The excavator will be able to track along the bund and reach the outer extent of the groynes.

The majority of work will be undertaken at low tide, however there will be periods where the works will be occurring up to the mid tide point. It is not practical for works only to occur during low tide due to the short window that low tide provides and the need to progress construction as quickly as possible to avoid lengthening construction effects.

It is noted in the Detailed Design Report (Appendix B) that a sea based method of construction may be used to construct the rock groynes. Subsequent to completion of that report, it has now been determined that the land based method is the only method proposed by Port Otago.

Works period

The construction of the rock groynes is expected to be undertaken five to six days per week and will take some six to eight months to complete (depending on weather and marine conditions, downtime etc.).

4.4.3 Sand nourishment

Sea-based beach nourishment methodology

The beach is proposed to be re-nourished with sand dredged from Otago Harbour which Port Otago has authority to do under the previously consented capital dredging resource consent (Resource Consent 2010.193) and as a permitted maintenance activity under the Otago Regional Plan: Coast (Rule 9.5.3.2). The sand will be sourced from the Harington Bend port side claim, as sand in that location has a suitable grain size (similar to that found on Te Rauone Beach) and is naturally clean.

Equipment to be used

The backhoe dredge, Takutai, will be utilised as a platform to pump sand ashore. It will sit on its spuds (piles lowered and raised to position the dredge) on the port side of the channel at Harington Bend. It will also have anchors deployed (by the work boat Kapu) with marker buoys. Takutai will be on site 5-6 days a week, and will establish on site on a slack high water.

Dredging method

A submersible dredge pump will be mounted on the boom of the Takutai and will move the pump much like it would for a digger bucket when in use. On board dredging software will be used to locate the pump within the dredge claim, and define the dredging depth. The sand production head fluidises the sand material on the sea floor with water jet assistance before pumping it to shore.

There are two possible methods for depositing the sand material from the dredge and onto the beach at Te Rauone. The most appropriate method will be determined depending on the profile of the beach at the time of the works and the level of containment the sand requires as result of that beach profile. Each method is outlined below.

Deposition methods

A polyethylene flexible hose (approximately 500 m in length) will be buoyed and anchored, and will run from the Takutai to the shore. A sand/sea water mix will be pumped ashore. The discharge end of the pipe will be fixed with waratahs allowing the sand/water mix to be discharged onto the beach below the MHWS mark. The seawater will run back into the harbour leaving the sand to remain on the beach. When sufficient sand has been deposited, the discharge end of the pipe will be moved along the beach and re-secured with the waratahs and a new delta created. Using this method, a series of overlapping deltas will raise the level of sand on the beach. The natural fall of the beach will ensure distribution of the sand pumped ashore with final levels achieved by use of machinery (light wheeled diggers or small dozers such as bobcats). This method is known as the Delta Model.

A further method that may be employed is the Bund Model. In this case, sand will be pumped from the Takutai to shore via a flexible hose into banded settling areas along the beach face.

The settling areas will have an overflow to allow the excess water to run back down the beach allowing the sand to settle. A grid pattern would be set up along the beach and when a banded area is filled. The hose will then be moved to the next banded area. The bund walls would be made of beach sand. After settlement of the sand, it would then be graded by machinery along the beach to achieve final levels.

Depending on the equipment sourced for this project it is estimated that it will pump at a rate of up to 300 m³/hr, working 8 hours each day, which would give approximately 2400 m³/day of sand/water on the renourishment site.

It has been assumed that approximately 30% of the sand/water mix will be sand. This will enable renourishment of approximately 800 m³/day or 4800 m³/6 day week. A proposed renourishment of 26,500 m³ will likely take around 10-12 weeks to complete (weather dependent).

Land based beach renourishment

Some land based re-nourishment will be required to provide a base of sand prior to the sea-based beach nourishment being undertaken. This would occur following the construction of the first and second groynes (northern and central groynes) and involve approximately 1,200m³ of sand. In this situation, Port Otago would rely on its existing consent (Resource Consent 2010.193) or permitted maintenance dredging to dredge sand and then existing Resource Consent 2009.146 and 2009.147 to bring sand ashore at T&U Wharf in Fryatt Street, Dunedin. Following this, trucks would be used to transport it to site. This would equate to approximately 200 truck movements (around 8 truck movements per day).

The sand will be either placed directly onto the beach (below MHWS) or be deposited on land immediately adjacent to MHWS and spread along the beach by appropriate machinery.

4.4.4 Public access restrictions

During construction works, public access to some areas will be limited to ensure public safety. These areas are expected to include the vehicle access track, the groynes (which will be prohibited to the public at all times during construction) and the relevant sections of beach that will be subject to construction. The majority of the reserve including the playground and pedestrian access areas will remain open to the public.

A plan showing these areas that are proposed to be restricted from the public during construction is attached within Appendix B and referenced as 3331121-SK-002.

During maintenance works, public access will be restricted to that portion of the site that is subject to the maintenance works, with the construction lay-down area and construction access used for the construction of the groynes expected to be reused for these purposes. A 'rolling' temporary fencing restriction will most likely be applied where restrictions to those portions of the beach undergoing maintenance will be fenced. Fencing will be moved along as maintenance works are progressed.

5. Matters requiring consent

5.1 Overview

The majority of the proposed works including the construction of the rock groynes and deposition of sand on Te Rauone Beach are located below Mean High Water Springs (MHWS). As a result, these works are governed by the rules contained in the Regional Plan: Coast for Otago (RPC).

The proposal has also been assessed against the provisions of the Second Generation Dunedin City District Plan (2GP) for works occurring above MHWS. As of 7 November 2018, all rules in the proposed 2GP decisions version (November 2018), which relate to the proposal, have legal effect.

5.2 Consent sought under the RPC

Table 1 and 2 outline the relevant rules and activity status of the proposed works under the RPC. Further assessment of all relevant rules is provided for within Appendix D.

Table 1 – RPC planning assessment – rock groyne structures

| Rule | Activity | Activity status |
|--|---|-------------------------------|
| <p>Chapter 7 Public Access and Occupation of Space</p> <p>Rule 7.5.1.5</p> <p><i>Occupation of the CMA by a structure unless provided for by Rules 7.5.1.1, 7.5.1.2, 7.5.1.3, or 7.5.1.4.</i></p> | Occupation of the CMA by the rock groyne structures | Discretionary activity |
| <p>Chapter 8 Structures and Signs</p> <p>Rule 8.5.1.9</p> <p><i>The erection of or placement of a structure or structures in, on, under, or over any foreshore or seabed unless provided for by Rules 8.5.1.1 to 8.5.1.6, 8.5.1.8 and 8.5.1.10.</i></p> | Placement of the rock groyne structures in the foreshore and seabed including connection of the northern groyne to the existing seawall which appears to be mostly above mean high water springs. | Discretionary activity |
| <p>Chapter 8 Structures and Signs and Chapter 9 Alteration of the Foreshore and Seabed</p> <p>Rule 8.5.2.3</p> <p><i>The maintenance, alteration, replacement or reconstruction of a structure, or part of the structure outside a Coastal Development Area, that is fixed in, on, under, or over any foreshore or seabed, other than as specified in rule 8.5.2.1 or 8.5.2.2 is a permitted activity ...</i></p> <p>Rule 9.5.3.4</p> <p><i>Clearing a coastal structure of natural material, and the disturbance of the foreshore or seabed when undertaking maintenance or minor alterations to a structure, and the launching of ships from the foreshore, is a permitted activity ...</i></p> | Maintenance of rock groyne structures once constructed. | Permitted activity |

Table 2 – RPC planning assessment – sand renourishment

| Rule | Activity | Activity status |
|--|--|-------------------------------|
| Chapter 9 Alteration of the Foreshore and Seabed Rule 9.5.3.6 <i>Any disturbance of foreshore or seabed not provided for by Rules 9.5.3.1 – 9.5.3.5.</i> | Disturbance of the foreshore and seabed during the works period. | Discretionary activity |
| Chapter 9 Alteration of the Foreshore and Seabed Rule 9.5.4.3 <i>Any activity involving the deposition of sand, shell, shingle, or other natural material in the coastal marine area not provided for by Rule 9.5.4.1.</i> | Deposition of sand during the beach replenishment works. | Discretionary activity |
| Chapter 10 Discharge Rule 10.5.6.2 <i>The discharge of water or contaminants into the coastal marine area not provided for by rule 10.5.6.1.</i> | Discharge of water and contaminants (sediment laden water) onto the beach during replenishment works | Discretionary activity |

5.3 Second Generation Dunedin City District Plan (2GP)

Table 3 outlines the relevant rules and activity status of the proposed works (where they extend above MHWS) under the 2GP.

Table 3 – 2GP Planning Assessment

| Rule | Activity | Activity status |
|--|--|--|
| Chapter 8A Earthworks Rule 8A.3.2(3) <i>Large-scale earthworks</i> | Movement of sand and re-contouring of the beach during replenishment works over the area and volume thresholds within 5 m of MHWS and the Hazard 3 overlay. Development of temporary site access including minor grading and deposition of aggregate over the area and volume thresholds within 5 m of MHWS and the Hazard 2 overlay. | Restricted discretionary activity |
| Chapter 10 Natural Environment Rule 10.3.2.3(c) <i>Indigenous vegetation removal</i> | Removal of indigenous vegetation where habitat for threatened indigenous fauna species may be located. | Restricted discretionary activity |
| Rule 10.3.3 – Setback from Coast and Water Bodies | Earthworks – large scale that is located within 20m of MHWS. | Restricted discretionary activity |

5.4 Consent requirement summary

Overall, the proposed works will require a coastal permit for a Discretionary Activity under the RPC for the proposed works below MHWS. Additionally a land use consent as a Restricted Discretionary Activity under the 2GP is sought for the works which may occur above MHWS.

6. Assessment of Environmental Effects

6.1 Overview

Under Section 104(1)(a) of the RMA, when considering an application for resource consent the consent authority must, subject to Part 2, have regard to any actual and potential effects on the environment. The actual and potential effects of the proposal have been evaluated to a level appropriate to the scale and significance of effects as required by Section 88 of the RMA.

This AEE assesses the effects on the environment that may arise as a result of the proposal and proposes mitigation methods to minimise any effects on the environment. The key effects that are discussed in detail below are as follows:

- Positive effects;
- Effects associated with earthworks;
- Effects on coastal process;
- Effects on ecological values;
- Effects on cultural values;
- Effects on natural character, landscape and amenity values;
- Effects on public access;
- Noise and dust effects;
- Traffic effects; and
- Effects on heritage and archaeological values.

6.2 Positive effects

It is legitimate to consider positive effects of the proposal as these are included in the definition of 'effect' in the Resource Management Act.

The application will create a number of positive effects for the Te Rauone Beach and the wider community including:

- Increasing beach amenity at Te Rauone Beach. The application of coastal engineering and sand renourishment proposed will re-establish a beach shape and profile consistent with the natural conditions of Te Rauone Beach prior to advanced erosion. Following the works, at least a 5m high tide beach will be present at Te Rauone Beach. This will make the beach one of the few remaining sandy beaches on the western side of the Otago Peninsula following the development of the historic sea walls and harbour training structures. Coupled with the intentions of the DCC to rejuvenate the Te Rauone Beach Reserve, the works will enhance local amenity.
- Te Rauone Beach is an area of deep historical, natural, cultural and spiritual significance. Its position near the entrance to the Otago Harbour and to the marae at Otakou means that it has been an important and well-loved area for generations of Kai Tahu on the Otago Peninsula. With the arrival of European ships in the early 19th century, Te Rauone became part of the development of the Otago Peninsula and Dunedin as we know it today. The proposed works will help preserve these matters of significance.
- Increasing coastal and natural hazard resilience. The proposed works at Te Rauone Beach which although have been designed to provide beach amenity with a high tide beach of at least 5 m, are expected to reduce the erosion affecting the beach, and may as a consequence

improve the erosion affecting nearby residential properties and the Te Rauone Beach Reserve. Residential properties at the northern and southern end of the beach have constructed their own rock revetment structures to counter erosion while the reserve is consistently losing land to the sea. There is the potential if erosion continues, that Harington Point Road may also become affected. The construction of the rock groynes may provide some protection against wider erosion through allowing for re-establishment of the beach.

- Increasing ecological habitat following the works. Ryder Environmental, who undertook the ecological assessment for the proposal, identifies in their report (Appendix E) that while some adverse effects on local ecology will be experienced during construction, the works have the potential to provide increased habitat in and around Te Rauone Beach when completed. This includes a new haul-out location for sea lions and tidal flat habitat for indigenous birds and benthic communities including native seagrass beds.

6.3 Potential adverse effects

6.3.1 Effects of earthworks/construction

Along with the proposed beach replenishment works located landward and seaward, minor landward works are required to establish laydown areas and construction vehicle access within the reserve and onto the beach. As mentioned above within section 4.4.1, these works are limited to:

- Temporary accessways, expected to comprise a running course of clean AP65 aggregate (approximately 1500m² area and 300m³ in situ volume) placed over geogrid/geofabric, with minor grading of the sandy backshore at the beach accesses to provide a smooth transition between land and beach (up to 400m² area and 300m³ in situ volume of grading);
- Temporary disturbance of the beach surface by vehicle stacks and excavation; and
- Minor stockpiling of sand and rock for beach nourishment and groyne construction.

Works will be temporary in nature and the effects associated will be also. Earthworked areas and stockpiles will be disestablished post construction which will fully remedy the effects of construction in terms of sediment and erosion and visual effects. There is low potential for release of fines. Clean aggregate will be used for the temporary accessways, which are to be laid on existing ground. The minor grading at the beach accesses is in the existing sandy backshore material, which allows for rapid infiltration of rainwater, limiting runoff.

Temporary disturbance of the beach surface by vehicle tracks and excavation for toe establishment around the groyne perimeter may also have some very minor effects. Any track marks and movement of sand are likely to be restored naturally over subsequent tidal cycles.

Effects on biodiversity values and natural character of the coast are further discussed below.

Overall, the proposed earthworks are considered to have less than minor effects given the temporary nature and very minimal amount of works proposed.

6.3.2 Effects on coastal processes

Hydrodynamics

The proposed works including the construction of the rock groynes and the introduction of new sand will inevitably alter Te Rauone Beach and the foreshore. As identified in the Coastal Process Assessment (CPA) (Appendix F) the works will affect hydrodynamics (including tidal current, wave action and tide levels) at Te Rauone Beach. This is intentional to achieve the required re-establishment of the beach and protection of it from ongoing erosion. The CPA states:

The proposed works have been designed to provide restoration of a usable beach crest which will, by its nature, move the high tide mark and corresponding lower intertidal beach face seaward of its present positions.

It is considered these effects are acceptable to achieve the desired protection and re-establishment of the beach which would be unachievable, under the proposed design solution, without altering those hydrodynamics of the area.

In regard to the effects on hydrodynamics for the wider Otago Harbour the CPA provides the following commentary:

The proposed beach management scheme marginally (0.4%) reduces the total cross-sectional area of the harbour at Mean Sea Level and is located in an area of low currents. As noted above, the area is also largely inshore of the historical shoreline. The proposed scheme will have no effect on harbour tide levels, as tide levels are driven by major global processes and the changes in cross sectional area are negligibly small. Similarly, the effects on tidal currents in the main channel and eastern channel are therefore expected to be negligible. There will be minor, localised current effects at mid-tide at the site, with the low velocity currents deflected around the groynes. Any localised increase in current velocity would be difficult to discern in practice because of the negligible reduction in cross sectional area and the low velocity of the existing currents. It is expected that effects at low and high tide, when currents are minimal, will be negligible. Overall, the effects on tides and currents are considered to be less than minor.

The modification to Te Rauone Beach will have little effect on hydrodynamics in the wider Otago Harbour due to the small scale of change occurring at Te Rauone Beach relative to the wider harbour area. The works are located close to shore with the groynes located a maximum of 80m offshore. As identified in the Detailed Design Report (Appendix B) the main harbour channel (where tidal currents are considerably stronger and could result in greater effects if altered) are some 400-500m offshore from Te Rauone Beach.

The potential effects of the rock groyne structures on natural wave action has also been mitigated through this appropriate design. The groynes have been designed with mild side slopes and voids between the rocks to dissipate wave energy. This reduces the potential for wave surges from deflection of the rock structures and associated erosion.

As a result the effects of any alteration to hydrodynamics at Te Rauone Beach and the wider Otago Harbour are considered less than minor.

Sediment processes and sedimentation

The placement of the rock groyne structures will reduce the movement of sediment at Te Rauone Beach to purposely reduce the amount of sand eroding from the northern end of the beach and accreting to the south. The coastal processes assessment identifies the following:

The rock groyne components have been designed to retain the added beach sand in position, with careful consideration to the minimisation of effects on adjacent areas of foreshore. Transport rates for sediment from the lower harbour north of Te Rauone Beach are minimal, and the northern groyne will not affect supply of this material. The northern groyne will assist in maintaining the new beach by reducing the exposure to wave energy from the north-east, translated wave energy derived from the rock-faced shoreline to the north, and vessel wake. The southern groyne will be constructed to allow sand to pass through it to the south to continue the existing sediment transport process, and will be assisted in this process by the initial (and ongoing) placement of sand on the south side of it to address the potential for

localised erosion downcoast of the groyne. This southward movement of sand, as with the present situation, has the potential to cause accretion at Wellers Rock Jetty. This will be monitored by surveys of water depths at Wellers Rock Jetty and beach profiles at the southern end of Te Rauone Beach.

While changes to the sediment process are desired at Te Rauone Beach through maintaining sand on the beach (see Appendix F section 5.5, for specific information on for how coastal process at Te Rauone Beach will be altered), the key effect wanting to be avoided is down coast effects from the restriction of natural sand movement. As identified above and in section 4.4.2, the southern rock groyne will be constructed without the geotextile core to allow movement of sand through the structure to the south. It is considered that this along with ongoing monitoring of coastal areas south of Te Rauone Beach will appropriately manage any potential effects associated with changes to natural sediment movement. The coastal processes assessment (Appendix F) outlines maintenance requirements. These include:

- relocation of sand within each embayment;
- recycling of sand from the accreting areas south of the site (subject to monitoring confirmation); and
- future renourishment using sand from channel dredging or similar.

A key potential effect of the project, if not managed properly, is sedimentation during the construction period. The deposition of sand onto the beach from the dredge and movement of machinery in and close to the water could cause significant amounts of suspended sediment, if not managed carefully. As identified in the Detailed Design Report (Appendix B) and section 4.4.3 above these management measures include:

- Obtaining sand from the Harington Bend port side claim which provides naturally clean sand of an appropriate grain size that is largely free of fine silt;
- Depositing of new sand above the tide level (using either the bunded method or delta method described in section 4.4.3) allowing settlement before sand is allowed to come into contact with the sea;
- Use of clean, quality rock for the groyne construction; and
- An average grain size of no less than 0.2mm and less than 2% fines will be used.

Sediment movement naturally occurs within the tidal waters of the harbour and during stormy weather events, large amounts of sediment can become suspended. Tidal action will move this sediment in the water and it will quickly settle. Furthermore, any discolouration will quickly diminish on completion of the works.

The ecological assessment undertaken by Ryder Environmental has also provided mitigation measures in regard to the potential for sedimentation to have an adverse effect on seagrass which is located outside of the project area to the south. Monitoring of these southern seagrass beds during construction is offered as a condition of consent to ensure suspended sediment loads do not exceed physical limits.

As a result, the temporary effects of sedimentation is considered to be no more than minor given the ongoing natural processes of the harbour in respect to sedimentation and the mitigation measures that will be undertaken during construction.

6.3.3 Effects on ecological values

Benthic communities

A key potential effect on benthic communities resulting from the proposed works is the loss of habitat through the deposition of rock groynes onto the seabed; vehicle traffic over seabed; and transient increases in turbidity when sediment is deposited (and “topped up”) onto the beach..

The ecological impact assessment provides the following commentary in regard to benthic communities and the impact of suspended sediment:

As the sediment proposed to re-nourish Te Rauone beach will include a range of size classes of substrate (i.e., fine to coarse), but a range entirely within the natural range for Otago Harbour, it will be possible for the fine sediment to become suspended in the immediate vicinity of the beach. The harbour normally experiences heavy sediment loading during flood and heavy rainfall events, and as such, it follows that the benthic communities are adapted to naturally turbid conditions. Due to the strong currents in the area and a relatively fast cycling of water in the harbour, it is likely that this will be no more than a short term, minor effect. We consider this potential effect to be no more than minor.

As identified in section 6.3.1, additional mitigation measures to reduce sedimentation will be undertaken such as sourcing clean sand and rock along with depositing above the high tide mark where possible, or within defined or bunded areas, to allow for settlement.

Balancing the resilience of the local benthic communities, the temporary construction period and the mitigation measures to reduce sedimentation during construction, it is considered the effects of suspended sediment on benthic communities will be no more than minor.

The permanent placement of the three rock groyne structures on Te Rauone Beach will result in the loss of habitat for benthic communities in those locations. Similarly machinery moving within the seabed will also disrupt these habitats.

In regard to the loss of habitat as a result of the construction of the rock groynes, the ecological assessment states:

The area where the groynes will be established will be lost, but due to the homogenous nature of the beach, the loss of this area is not considered a highly significant effect. This assessment is supported by the results of the benthic sampling reported...[and] Dr Stewart believes that some elements of the macroinvertebrate communities may even be able to migrate out of this area as rock substrate is placed upon the shore meaning a total loss scenario may not occur. We consider this potential effect to be no more than minor. In regard to the effects of physical disturbance by vehicles, the report concludes that:

The proposed works to install the rock groynes will result in loss and/or disturbance of the seabed and resident benthic communities, as the machinery moves backwards and forwards over the bed to retrieve rocks from the stockpile and place the rocks on the groynes. This short-term, temporary effect is not considered significant, In addition, previous researchers have suggested that any infauna communities lost and/or disturbed over the duration of the POL works to build groynes at Te Rauone will recolonise the scheme footprint area over a period of one or two years. We concur with this assessment. We consider this potential effect to be no more than minor.

Field analysis undertaken in the development of the ecological assessment found that no cockle beds were located within proximity to Te Rauone Beach. Although significant cockle beds, or any cockles at

all, were not detected within the footprint, it is almost certain that cockles are present within the project footprint either as spat, or juveniles/sub-adults/adults (albeit at low densities).

The report outlines the effects on cockles:

The replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of cockles.

...we expect losses will occur in any cockle habitat that currently lies beneath the area where the rock groynes will be placed...We accept that there will be losses where groynes are installed, but note that natural recruitment of cockles in the area has been recorded.

The effects of this vehicle movement on cockles at Te Rauone will be at least partially mitigated by the robust nature of cockles, being often referred to as "bioturbators". Cockles are highly mobile and capable excavators, able to resurface within days (often hours) from under 2, 5 and 10 cm, and even 25 cm, of sediment, where no physical disturbance to their natural (in situ) orientation had occurred...There may, however be some losses/deaths of the low-density cockle beds of the schemes footprint as a result of vehicle traffic.

Overall, we anticipate the effects of the scheme on cockles of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together

It is also acknowledged that the ecological assessment identifies the re-establishment of Te Rauone Beach may provide for the growth of native seagrass beds which provide habitat for a wide variety of intertidal invertebrates, fish and feeding grounds for birds.

It is considered due to the disruption of benthic habitat being temporary and the re-colonisation of the footprint area likely to be enhanced by the works, the effects of habitat loss on benthic communities is no more than minor.

Seagrass beds

Seagrass beds were not detected within the project footprint, however extensive seagrass beds are located to the south of the project area. The ecological assessment considers that seagrass is not found within this area due this area naturally experiencing high sediment movement unsuitable for seagrass establishment and growth.

As mentioned above and within Section 8 of the ecological assessment (Appendix E). The replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of dense native seagrass beds.

Sedimentation does pose a threat to the seagrass beds to the south of the project site, however the ecological assessment states:

Due to the cyclical nature of the tides in the outer harbour, coupled with the location of the scheme footprint near to the harbour entrance and our experience, we hold the firm view that fine sediment, which is most threatening to seagrass condition and growth, will not be retained in the area for longer than known tolerance levels. More importantly, we do not believe fine sediment that is retained following re-nourishment (including top-ups) will drift up the harbour to reach lethal levels over the existing seagrass beds over to the south of Te Rauone Beach, and as we understand it, it is unlikely that the intermittent "top ups" will be of a scale comparable to the initial works and as such, the effects will be less than those of the first re-nourishment attempt.

While adverse effects on the southern seagrass beds are not expected, due to the potential for unforeseen effects associated with maintenance and construction, a conservative approach has been applied through an adaptive management approach which is discussed further below and included as proposed conditions of consent.

Overall, effects on existing southern seagrass beds located immediately south of the project footprint are considered to be low risk and minor, with the positive effects of additional tidal flat areas for establishment of seagrass and the proposed adaptive management conditions proposed outweighing any unlikely adverse effects.

Sea mammals

The ecological assessment identifies the Hooker's Sea Lion as sea mammal most likely to be affected by the proposed works at Te Rauone Beach. The assessment highlights that:

Sea lions resting or socialising on the southern reaches of Te Rauone Beach, or any that occur or attempt to haul up onto the northern areas of the scheme footprint, may suffer disturbance by noise, vibration and human presence as the groynes are constructed. Disturbance may cause sea lions to be temporarily displaced from the beach, during works...Machinery movements, including the placement of rocks onto the seabed and groynes, may injure/displace any sea lions moving in and around the scheme footprint.

Sea mammal management measures are proposed to be implemented within the proposed Environmental Management Plan (EMP) to mitigate any potential impacts on marine mammals. This plan will include the requirement for a sea lion expert to conduct an on-site briefing to contractors, as to the protocols DOC/the consent requires, prior to all works commencing. The management measures will include that the proposed works are not undertaken during the period from mid-December-early February.

During the field assessment undertaken for the ecological report, no sea lions were observed near Te Rauone Beach. This was identified as being likely due to the lack of sandy beach habitat which reduces the area as a suitable haul-out location for sea lions. The assessment highlights that:

The scheme development, by replenishing the sediment of Te Rauone Recreation Reserve, will have a potential positive effect on sea lions by providing greater expanses of sandy beach habitat they favour, a habitat that is rare in the inner Otago Harbour. In addition, by sculpturing the foredunes to visually replicate the dune system of the southern reaches of Te Rauone beach, the back dunes will again be easily accessible to sea lions.

The creation of sandy beach habitat over the northern part of Te Rauone Beach, a valuable resource for sea lions of the inner harbour, will offset entirely any potential adverse effects of the scheme on sea lions and by doing so will leave no significant residual adverse effects on sea lions. Naturally occurring sandy beaches, except for Te Rauone, are not present in the inner Otago Harbour. With this in mind, a net gain in sandy beach habitat will occur following the successful renourishment of beach at Te Rauone.

As a result of these findings, the potential significant positive effects, and the management proposed to avoid harm or disturbance to sea mammals if they do become present on site, it is considered any adverse effects on these animals will be less than minor and fully offset by the benefits that the completed scheme will offer to sea lions.

Birds

A number of birds, including indigenous and at risk species, were observed on and flying over Te Rauone Beach during the field assessment. Despite their presence, the ecological report confirms:

Overall, we anticipate the effects of the scheme on indigenous birds of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together. We base this assessment on the following:

- *Only red billed gulls and variable oyster catcher were found within the footprint, these in low numbers (<5 individuals sighted) and only intermittent use (based on low build-up of faeces/guano on the rocks).*
- *Records from the wider area indicate only occasional visits by other species, and the most likely species to be a regular visitor in any numbers, apart from the red billed gulls, is the variable oyster catcher; but available records of this species were sparse over the northern Te Rauone beach.*
- *There was no evidence of indigenous birds roosting (little shags) or nesting (penguins) within the footprint, and no evidence of any critical habitat for any indigenous bird species present. .*

As a result it is considered that the effects of the project are likely to have a temporary disruptive effect rather than impacting the health and breeding patterns of any species of bird identified in the ecological report. The noise, vibration and presence of vehicles and people will have some disruptive effects along with the removal of resting spots such as deadwood and stumps currently located on the beach.

However as identified in the ecological report, these effects will only be temporary during the construction period and bird resting locations will be increased through the development of the rock groyne as stated within the assessment:

Notwithstanding the ample availability of resting habitat for this species, in our view, any effects of the Te Rauone scheme on red billed gulls and their habitat, and on any occasional visitors to the northern part of the beach, is entirely offset by the provision of up to 210-240 m of rock groyne habitat following the completion of the scheme. Indeed, a net increase in resting (as well as wading) bird habitat is anticipated.

As a result, it is considered the effects on bird species which frequent Te Rauone Beach will be temporary in nature and are considered less than minor and offset by benefits that the completed scheme will offer as bird habitat.

Vegetation removal

The removal of small areas of indigenous vegetation, namely pohuehue vineland, to construct access tracks will reduce the amount of indigenous vegetation over the Te Rauone Reserve. This effect as it relates to the vegetation itself, is considered less than minor, but the effect on potential habitat of the southern grass skink (lizards) is considered more than minor, if not mitigated. The lizard effects are discussed below further.

The removal of some exotic vegetation and trimming of mature tree branches may also remove roosting habitat for little shags, or any other resident birds. The effects of this are considered less than minor given the added roosting options that will be provided by the construction of the groyne and that the removal of vegetation is very limited.

Lizards

The southern grass skink was detected during the field assessment at multiple sites along the fore dunes of Te Rauone Beach. The species is currently listed by DOC as a nationally at risk/ declining species. The ecology report identifies:

The grading of the landward berm of the beach with concomitant removal of habitat currently used by southern grass skinks; and the removal of small areas of pohuehue vineland over the Te Rauone DCC Reserve may result in the disturbance, death, injury and/or displacement of any southern grass skinks present over these areas at the time of works.

We consider these potential effects to be more than minor.

To manage the effects on the southern grass lizards within the works area, a site specific management plan will be developed and presented to Council prior to works beginning. As proposed in the ecology assessment, the management plan will include measures to avoid impacts on lizards such as the following identified in the Ecological Assessment:

Southern grass skinks are present throughout the scheme footprint, and were found in highest numbers in and around MHWS mark. With this in mind, 'no-go' zones that contain southern grass skinks or their habitat will be negotiated on-site with contractors, and marked on the ground for avoidance, prior to the commencement of works. Notwithstanding these no-go zones, storage and access tracks/vehicle parking will use existing clearings and roads to further minimise the potential impact on southern grass skinks.

To undertake works within habitat of the at risk southern skink, a permit will be required under the New Zealand Wildlife Act. Both the requirement for the Wildlife Act permit and the site specific management plan are offered as conditions of consent in Appendix G of this application. It is noted that this permit will be applied for post granting of consent.

Through the effective management of the southern grass skink with the appropriate permit under the Wildlife Act and the site specific lizard management plan, it is considered the effects of the project on lizard species can be mitigated to be no more than minor.

Adaptive management

An adaptive management approach is proposed to manage the effects that have an element of uncertainty relating to marine benthic communities and seagrass beds. This approach is provided for within the proposed conditions of consent within Appendix G and includes monitoring and remediation of benthic communities and monitoring, remediation and rehabilitation of the southern seagrass beds, if unexpected effects arise.

Further detail of this approach is provided within the Ecological Assessment attached within Appendix E.

This management approach provides for mitigation and management post construction and during maintenance periods and is considered to provide sufficient mitigation to ensure that the effects on benthic communities and seagrass are no more than minor.

6.3.4 Effects on cultural values

As discussed in section 6.2 above, Te Rauone Beach is an area of deep historical, natural, cultural and spiritual significance. Port Otago has worked closely with Te Rūnanga o Ngāi Tahu in collaboration with TRBCCC to ensure input into the beach protection solution was inclusive. Aukaha, on behalf of Port Otago, sought formal consultation on this application with Te Rūnanga o Ōtākou, who have confirmed that they do not oppose the application proceeding by a non-notified resource consent process, subject to conditions which are discussed within section 8 below.

Further to this, the project will improve and reclaim the lost beach and protect it from further erosion. This will assist in maintaining those values that mana whenua hold. The construction works, including minor earthworks landward of MHWS will be monitored to mitigate the effects associated and will be temporary in nature.

Furthermore, while kaimoana will be temporarily disrupted, the ecological assessment has identified that the proposed groynes and renourishment will have a positive effect on fauna and benthic communities, allowing for Manawhenua to continue to practice their tikanga.

The effects on cultural values are therefore considered to be no more than minor.

6.3.5 Natural character, landscape and amenity values

Preserving the natural character of the coastal environment and protecting it from inappropriate subdivision use and development is a matter of national importance under the RMA. Natural character is generally understood to include landforms and features including beaches, as well as coastal processes and values which contribute to naturalness. Coastal processes and ecological values are addressed above. In terms of the other components of natural character, we firstly note that the site does not have high natural character or contain any high or outstanding natural features or landscape values. Our assessment is based on a report commissioned by the ORC and DCC to inform the reviews of the Otago RPS and the 2GP prepared by Mike Moore Landscape Architect¹. The report, while not forming part of the RPS or the RPC at this stage, is nonetheless relevant to understanding the natural character and landscape values at the site. Te Rauone is mapped by Mr Moore as a “unit or feature with low or medium value”. Accordingly, natural character effects arising from the proposed beach enhancement scheme will arise, but these effects are considered to be minor and appropriate effects due to the modified nature of the natural character in this location.

Effects on amenity values are also relevant. Amenity values are defined in the RMA as:

“Those natural or physical qualities and characteristics of an area that contribute to people’s appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes”.

The key objective of the project is to improve the amenity values of Te Rauone Beach. This has resulted from strong lobbying from the TRBCCC who, for a long time, have pushed for action to be taken to rebuild the beach and restore those amenity values once associated with the area. Consultation identified the qualities and characteristics of the beach prior to advanced erosion including:

- The ability to walk along the beach at high tide;
- The presence of vegetated sand dunes;
- The presence of tidal flats.

Currently, as a result of the advancing erosion:

- the beach is unable to be accessed at high tide as there is no high tide beach berm;
- the beach has a build up dead wood and tree stumps from trees which have been uprooted from the erosion; and
- The sand dunes have been eroded away along with land which makes up the Te Rauone Beach Reserve.

¹ Coastal Environment of Otago: Natural Character and Outstanding Natural Features and Landscapes Assessment, Dunedin City Section Report, prepared by Mike Moore, dated 28 April 2015

The re-nourished foreshore will restore much of the amenity lost through the advanced erosion experienced in the area through re-establishment of the beach berm and protection from further erosion.

It is recognised that the rock groyne structures located on the beach may detract from amenity in the area. This is due to their size and the reduced visual amenity associated with engineering structures in the coastal marine area. A visual representation of what the rock groynes will look like has been developed and is attached in Appendix J. While less visible at high tide, the rock groynes will be easily seen from Te Rauone Beach.

The visual impacts of the rock groynes were considered during the design phase. The design only proposes the absolute minimum bulk, length and number of groynes required to ensure re-establishment of the beach is achieved. The seaward end of the groynes will also only be constructed to the height of Mean Sea Level to reduce visual impacts.

The rock groyne design approach was the favoured option of a number of considered options by Port Otago and discussed with Council and the TRBCCC. Consultation on the proposed option found it was considered by the community that the rock groyne structures detracted little from the amenity, including visual amenity, of the beach in comparison to those benefits gained through its re-establishment.

When considering the visual impacts of the structures, it is also important to consider that the coastline of the Otago Harbour is highly modified. The historic coastal sea wall runs almost the full length of Portobello Road and significant sections of Harington Point Road while rock groynes have been used to train the harbour channel for over a century. As a result, it is not considered that the rock groynes located on Te Rauone Beach would be out of character with the wider environment which is accustomed to coastal engineering.

This is supported by the visualisation in Appendix J which shows what the groynes will look like from the shipping channel. It is considered that whilst the groynes will be visible, from a distance the rock groynes will blend into the wider landscape and already modified coastal environment. This is due to factors such as their low profile design and the rock material proposed to be used. It is considered the colour and texture of the rock against the coastal background prevents the groynes being highly dominant or obtrusive from viewpoints within the channel, the other side of the harbour or from further along the Otago Peninsular.

In light of the above, adverse effects on amenity as a result of the rock groynes within the coastal marine area are considered no more than minor with the aim of the project to provide positive amenity effects through restoration of the beach.

6.3.6 Effect on public access

Due to the use of machinery necessary in undertaking the works, there will be some temporary restriction of public access within the coastal marine area. This will include restricting public access from sections of the beach during periods of work. These restrictions will only be temporary and will only occur while works are undertaken which may endanger the public.

When constructed, the groyne structures will also allow for public access along the beach. The northern groyne will join to the existing rock revetment structure located in front of the properties at the northern end of Te Rauone Beach. The central groyne will be free standing with walk through access at its landward end. Finally the southern groyne also provides access at its landward end where it joins with the existing sand dunes. A boardwalk and steps (leading to the beach) at the southern groyne are included as part of these works and will tie into the DCC revitalisation works of the Te Rauone Beach Reserve. Information in regard to the boardwalk location is provided on the plan referenced 3331121-CA-103 attached in Appendix B.

Future maintenance works may be required to top up sand and undertake rock groyne maintenance throughout the consent period. During these times, public access to some areas may need to be limited to ensure public safety also.

As the effects to public access are only temporary during the works period and access is not restricted by the development of the rock structures, the effect of the proposal on public access is less than minor. As identified in section 6.2 above, the works will improve access to the beach (especially at high tide) due to the re-establishment of the sandy beach berm.

6.3.7 Noise and dust effects

Noise will be emitted during the works period at Te Rauone Beach from the operation of marine and land-based machinery and the movement of vehicles to and from site.

The proposed works are located within proximity to a group of residential properties at the northern and southern ends of the beach. All works will be undertaken in accordance with the New Zealand Standard for construction noise, NZS 6803:1999 Acoustic- Construction Noise and construction will be limited to normal daytime working hours.

There is very limited potential for dust to be produced by the construction work given the wet nature of the sand to be used for the replenishment works.

Due to the temporary nature of the construction noise and the limited potential for dust emissions, any associated effects are considered as less than minor.

6.3.8 Traffic effects

Road based transport

Heavy vehicles will be used during the construction period to transport rock and sand to Te Rauone Beach. A Traffic Impact Assessment (Appendix C) was undertaken to determine the effects truck movements might have on the local road networks through increased heavy vehicle movements. It has been estimated around 11 truck movements a day will be required to haul sufficient amount of rock to site, dropping to 8 truck movements a day for sand (rock and sand will not be moved concurrently). The Traffic Impact Assessment concludes:

The traffic volumes in the environment are sufficiently low that an additional 11 round-trip truck movements per day i.e. up to three round-trip truck movements per hour will have a less than minor effect on the traffic flow in the network. Assuming three trucks on rotation there should be on average a separation of 20 minutes between trucks, which will mean that the trucks should not back up at the intersections.

A further 8 vehicles a day will likely drive the route to Te Rauone Beach to transport machinery and/or personnel. The road network is also expected to be able to accommodate these vehicle movements.

The assessment identified a narrow section of road where lane widths could present conflicts if trucks in the fleet happened to meet at that section of the route. While the likelihood of the vehicles meeting at this point is low, safety procedures such as two-way radio communication between vehicles and using the same drivers throughout the project where possible will be used. These requirements will be included in a Traffic Management Plan which will be lodged with Council prior to the works beginning. The management plan will also include designated truck and trailer wait areas, safe turning facilities and access through the site. Locations of these are yet to be determined and do not form part of this consent, however it is expected heavy vehicles will be limited to designated access ways and routes along the beach, as directed by the Community and Recreation Services department (CARS), to limit potential impacts.

Due to the adequate capacity of the road network, the construction period only being temporary and the proposed development of the Traffic Management Plan, it is considered the traffic effects will be less than minor.

Sea based transport

To ensure the safe operation and movement of the vessels in the harbour and shipping lane, a number of safety requirements will be undertaken while the sand deposition works are occurring. This will include:

- Nautical lights and day shapes (nautical signals) whilst the Takutai is operating as required by maritime rules;
- The hose depositing sand ashore will be anchored and buoyed to provide visibility of its location to boat users; and
- Port Otago will provide a Notice to Mariners to LINZ for issuing
- Harbour control will let public crafts in the area know of the works and any associated hazards.

Prior to the works beginning all measures to ensure safety within the harbour will be required to be authorised by the Otago Harbour Master. As a result, it is considered effects on navigational safety for boat users and other vessels will be less than minor.

6.3.9 Heritage and archaeological values

As identified in Section 3.3 above, site visits while developing the project has uncovered historic timber groynes located in the shallows at Te Rauone Beach. GPS recordings have indicated that the location of one of the groynes is within 10m of the proposed southernmost groyne. To ensure preservation of the timber groyne, the location shall be confirmed prior to contractor engagement. An Archaeological Authority will also be obtained prior to works commencing as a precautionary measure. This is offered as a condition of consent (see Appendix G) along with normal accidental discovery protocols to protect any artefacts if uncovered during the works.

No other findings of heritage or archaeological significance have been found through the site visits and research undertaken by archaeologist Dr Matthew Schmidt and Otakou Runaka representatives Hoani Langsbury and Sarah-Jane Cuthers.²

6.4 Summary of effects

Overall, there will be some effects on coastal processes in the area of Te Rauone Beach as this is necessary to re-establish the beach for amenity purposes and provide protection against the coastal processes which are currently causing significant erosion. These effects are considered to be localised and will have no more than minor adverse effects on the wide harbour area. Design features have been incorporated to allow some natural movement of sediment. Sedimentation as a result of the construction works will be mitigated through construction practices described above and will only be occurring over a temporary period.

The potential adverse effects on local ecology will be appropriately managed through an adaptive management approach, and implementing measures to reduce sedimentation, implementation of the identified sea-mammal disturbance protocols, the development of the proposed lizard management plan and the permit to be obtained under the Wildlife Act.

The effects on cultural values are considered to be no more than minor given that the restoration of the beach will enhance the values that mana whenua hold for Te Rauone Beach.

² Findings were concluded at a site visit undertaken on 29/11/2019.

While some adverse effect on visual amenity may occur through the placement of the rock groynes on the beach, the benefits of re-establishing the beach are considered to outweigh those.

Noise will be managed to meet the relevant noise standards. Dust is unlikely to be produced through the works due to the wet nature of the sand being deposited on the beach.

Public access will be temporarily restricted but only to ensure public safety during the construction period. Amenity is still provided through access to the playground area and the majority of the DCC reserve. Lay-down and access areas have been carefully thought out to ensure the least disturbance to public areas and to vegetation and animal habitats.

The local road network is expected to be able to support the increased movement of trucks over the construction period. Safety protocols will be used to ensure the safe movement of these vehicles along with the sea based craft used throughout the project.

The historic timber groynes of archaeological interest are unlikely to be affected by the works, however an Archaeological Authority will be obtained prior to works commencing.

Having regard to the description of the proposal and the scale and nature of effects created by the proposed works, it is assessed that the actual and potential adverse effects of the activities are no more than minor and that significant positive effects for the environment and the local community will arise as a result of the proposed beach renourishment.

7. Statutory Assessment

7.1 Part 2 assessment of the RMA – Purpose and principles

Part 2 sets out the purpose of the Act, the matters of national importance, other matters and the obligations in respect to the Treaty of Waitangi. All resource consent applications are subject to Part 2.

Part 2 of the RMA, the purpose and principles, is set out in sections 5 to 8 of the Act. Section 5 states that the purpose of the Act is to "to promote the sustainable management of natural and physical resources".

The use, development and protection of resources are only allowed while:

- (a) *"sustaining the potential of natural and physical resources, (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- (b) *safeguarding the life-supporting capacity of air, water, soil and ecosystems; and*
- (c) *avoiding, remedying, or mitigating any adverse effects of activities on the environment".*

The proposal is assessed above as having no more than minor effects on the environment. The proposal will have little adverse effect (if any) on the Otago Harbour's ability to meet the reasonably foreseeable needs of future generations. The proposal does provide for the enjoyment of the beach by future generations through the regeneration of a beach which will be lost if left to erode. The proposal will have only a short term adverse effect on the life-supporting capacity of the affected coastal marine area, while the ecosystem is expected to adapt to the groynes and introduced sand foreshore. Consent conditions can ensure that any long term adverse effects in the environment are mitigated.

Section 6 of the RMA requires that in assessing the applications, the following matters of national importance are recognised and provided for:

- (a) *The preservation of the natural character of the coastal marine area, wetlands, and lakes and rivers and from inappropriate subdivision, use and development.*
- (b) *The protection of outstanding natural features and use, and development.*
- (c) *The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.*
- (d) *The maintenance and enhancement of public access lakes, and rivers.*
- (e) *The relationship of Maori and their culture and traditions sites, waahi tapu, and other taonga.*
- (f) *The protection of historic heritage from inappropriate subdivision, use and development.*
- (g) *The protection of protected customary rights.*
- (h) *The management of significant risks from natural hazards.*

The rock groynes will alter the coastline. However, along with the sand re-nourishment, will help re-establish the natural character of the area.

The RPC recognises that the Otago Peninsula has outstanding natural features (Schedule 3.2). Within the foreshore affected by the application, no outstanding natural features have been identified. The District Plan identifies an existing seawall in the vicinity of the works as a heritage item however no works are proposed to this wall.

Whilst some indigenous vegetation will be removed and could affect the habitat of indigenous lizards, the proposed mitigation measures and conditions relating to lizard management will ensure that lizards are not adversely affected.

Public access to the coastal marine area will be restricted during construction, but significantly enhanced upon completion.

Section 7 of the RMA requires persons acting under the Act in relation of managing the use, development, and protection of natural and physical resources, to have particular regard to various matters. In the context of the present application the following matters are relevant:

- the efficient use and development of natural and physical resources
- kaitiakitanga
- the ethic of stewardship
- intrinsic values of ecosystems
- maintenance and enhancement of the quality of the environment
- any finite characteristics of natural and physical resources

The proposal is assessed as not adversely affecting any of the matters above. The application has the support of those parties who have particular interests in the area, as detailed in Section 8 of this report. The local ecosystems will be temporarily impacted during the construction works but are expected to regenerate and eventually be enhanced by the re-establishment of the beach. The quality of the environment will also be enhanced for both the public and private interests.

Section 8 of the Act requires the principles of the Treaty of Waitangi to be taken into account through active partnering with mana whenua on the development of this proposal.

We note the application has high level support of local iwi representatives and further iwi consultation is being undertaken in relation to this application to confirm this as discussed in Section 8 below.

7.2 Sections 104(1)(a)

The actual and potential effects on the environment have been assessed in Section 6 above. The assessment concluded that the actual and potential adverse effects of the proposal will be no more than minor and there will be significant positive effects generated by the proposed works at Te Rauone Beach.

The relevant provisions of the legislative framework and relevant planning documents are considered below. This assessment concludes that the proposal is in general accordance with the relevant provisions of these documents.

7.2.1 New Zealand Coastal Policy Statement 2010

The New Zealand Coastal Policy Statement (NZCPS) provides a policy framework to achieve the purposes of the RMA in relation to the coastal environment of New Zealand.

The activities proposed at Te Rauone Beach are considered to meet the relevant objectives and policies outlined in the NZCPS. The works will enhance the form, function and resilience of Te Rauone Beach through its re-establishment and protection from ongoing erosion. This will increase the natural character and values of the beach along with providing greater access and amenity to the public. While some impacts on local ecosystems will occur during construction, it is considered this will only be temporary with habitat likely to be created through the re-establishment of the beach.

The NZCPS promotes natural protection of the coastal marine area over other forms of coastal defences. Coastal engineering is the proposed method to achieve the desired outcome at Te Rauone Beach as erosion processes in the area are too strong for development of natural defences to be

established and successful. Port Otago and TRBCCC also consider the proposed hard protection approach justifiable due to significant public benefit in re-establishing the beach.

As a result it is considered the relevant objectives and policies of the NZCPS are able to be met by the project. A full list and analysis of these objectives and policies for the project is contained in Appendix H.

7.2.2 Partially Operative Regional Policy Statement 2019

The Partially Operative Regional Policy Statement (PORPS) contains a high level policy framework for the sustainable integrated management of Otago's natural and physical resources, to be managed by the region's local authorities.

The activities proposed at Te Rauone Beach are considered to meet the relevant objectives and policies outlined in the PORPS. The reinstatement of Te Rauone Beach will provide for tangata whenua to continue customary uses while maintaining and enhancing the values they hold for Te Rauone. The construction of the rock groynes will reduce ongoing beach erosion and improve the amenity of the beach and provide for public use. Port Otago and TRBCCC consider that there is significant public benefit in re-establishing Te Rauone Beach which justifies the use of hard protection structures. The beach would be one of the few remaining sandy beaches located on the western side of the peninsula which contributes to the values and character of the area.

As a result it is considered the relevant objectives and policies of the PORPS are able to be met by the project. A full list and analysis of these objectives and policies for the project is contained in Appendix H.

7.2.3 Regional Plan: Coast for Otago

The RPC provides a policy framework specific to Otago's coastal environment to be managed by the ORC.

The activities proposed at Te Rauone Beach are considered to meet the relevant objectives and policies outlined in the RPC. As identified above the works will enhance the character, natural features and amenity at the beach through its re-establishment. It is considered while there are some impacts on visual amenity in regard to the rock groynes being located in the coastal marine area, these are outweighed by the amenity the restored beach will provide. Similarly the disturbance to the seabed and foreshore is considered acceptable due to the benefits of restoring the wider beachscape. The placement of the structure within the coastal marine is sensitive to the surrounding environment as coastal protection structures are common along the western coast of Otago Peninsula. The impacts on natural processes as a result of the works are not considered to have a noticeable impact on areas surrounding Te Rauone Beach and the wider harbour area.

As a result it is considered the relevant objectives and policies of the RPC are able to be met by the project. A full list and analysis of these objectives and policies for the project is contained in Appendix H.

7.2.4 Second Generation Dunedin City District Plan (2GP)

The 2GP provides a policy framework which reflects the responsibilities that Dunedin City Council holds as a territorial authority. The provisions of the relevant objectives and policies outlined in the 2GP are only relevant to those works occurring above MHWS.

In alignment with the 2GP, the proposed works provide effective protection to counter the erosion that has largely removed the beach at Te Rauone Beach while improving amenity values, avoiding effects on mana whenua values and character of the adjoining recreation zone. The use of hard protection

options are a result of the significant adverse effects erosion has had on amenity and character of Te Rauone Beach.

As a result it is considered the relevant objectives and policies of the 2GP are able to be met by the project. A full list and analysis of these objectives and policies for the project is contained in Appendix H.

8. Consultation

The following consultation has been undertaken as part of this application. Full correspondence is provided within Appendix I.

| Stakeholder | Consultation |
|--|--|
| <p>Te Rauone Beach Coast Care Committee (TRBCCC) and other community representatives</p> | <p>TRBCCC are a community group that were formed in light of the loss of beach and amenity. TRBCCC have been a vocal community group who are passionate about the reinstatement of Te Rauone Beach. Their vision statement includes <i>“to re-instate a safe and accessible beach amenity that can be utilised and enjoyed by all members of our diverse community”</i>. Port Otago has been working closely with TRBCCC to realise the project since 2008. An extensive timeline of meetings is provided within Appendix I which highlights the ongoing collaborative approach the project has had. The community meetings have been inclusive and have involved residents of Te Rauone Beach, iwi representatives, elected officials, the wider public, Otago Community Trust, Department of Conservation and the Otago Regional Council.</p> <p>The general outcomes and feedback received within the meetings have been positive with strong support and an eagerness to get the project moving. There has been no negative feedback minuted at the meetings held by and with TRBCCC.</p> <p>Mr Des Smith, who is a Committee Member of TRBCCC has provided a letter of support for the project. In addition to this, a range of letters of support from numerous community groups/stakeholders has also been provided. These letters are also attached within Appendix I.</p> |
| <p>Department of Conservation (DoC)</p> | <p>Port Otago has been in consultation with DOC on this project since 2011 when their initial support was sought for the first beach protection works option. Consultation at the time of lodgement of this application is ongoing with DOC currently reviewing the AEE. DOC staff have highlighted that their main concern is in regard to how the work will be completed and what steps will be taken when encountering marine mammals such as sea lions (during the restoration work).</p> <p>The ecological impact assessment attached within Appendix E has provided a recommended protocol in regard to the protection and interaction with sea lions. A condition of consent has been provided to avoid any adverse effects with sea mammals.</p> <p>Written approval from DOC is expected to be provided in due course.</p> |
| <p>Heritage NZ</p> | <p>Port Otago has also been in consultation with Heritage NZ since the first beach protection options were considered in 2011.</p> |

| | |
|--|--|
| | <p>Heritage NZ has highlighted in recent consultation (November 2019) that there is evidence of earlier groynes constructed on the beach in the 1890s.</p> <p>Port staff met with Dr Matthew Schmidt (Heritage NZ), Hoani Langsbury (Otakou Runaka) and Sarah-Jane Cuthers (Komiti Coordinator, Otakou Runaka) on site on the 29th November 2019 to look at the archaeological features on Te Rauone Beach with the key items being the 1890 timber groynes.</p> <p>Evidence of the southernmost timber groyne was found but nothing of note was located near the location of the proposed rock groynes.</p> <p>Heritage NZ would require an Archaeological Authority in place prior to commencement of works on site and are currently reviewing the AEE.</p> <p>An Archaeological Authority will be obtained prior to works commencing to satisfy Heritage NZ's requirements and a condition of consent is provided in Appendix G below.</p> <p>Further correspondence with Heritage NZ will be provided to Council once received.</p> |
| <p>Aukaha on behalf of Te Rūnanga o Ōtākou</p> | <p>Consultation with iwi has been ongoing via Mr Edward Ellison - Te Rūnanga o Ōtākou. Consultation has included numerous drop in sessions at the marae with evidence of such provided within the timeline of meetings held by TRBCCC. A letter of initial support for the project was provided by Te Rūnanga o Ōtākou on 21st November.</p> <p>Following the writing and circulation of the draft resource consent application, further written support from Te Rūnanga o Ōtākou was sought through Aukaha. A letter from Aukaha on behalf of Te Rūnanga o Ōtākou, the kaitiaki Rūnanga, whose takiwā includes the site the application relates, was provided on 29th November 2019 (attached within Appendix I). The letter outlines conditions of their support which have been provided as conditions of consent where possible. It is noted that further clarification regarding condition 1 of the letter has been sought from Aukaha. Whilst Port Otago acknowledge Te Rūnanga o Ōtākou's concerns in regard to the works (sedimentation and effects on water quality), requiring that "works should be undertaken at low tide as much as possible" is not practical given the short window that low tide provides and the need to progress the construction as quick as possible to avoid lengthening any construction effects. In addition, carrying out the work at or near low tide would reduce lateral movement of the sediment plume due to slack tidal flows. As the magnitude of any sedimentation is likely to be minor, and likely temporary against background turbidity, lengthening the construction programme to accommodate low tide construction, greatly outweigh the short lived effects of sedimentation.</p> |

| | |
|----------------------------|--|
| | <p>Furthermore, construction effects will be monitored and sedimentation effects mitigated through the proposed conditions within Appendix G.</p> <p>Whilst Port Otago is committed to meeting the conditions that Te Rūnanga o Ōtākou have included within their written approval, compromise must be sought in regard to condition 1 due to the impracticality and feasibility of this condition. In addition to this, the effects of the works are deemed to be minor. At the time of lodgement, Port Otago are awaiting confirmation from Aukaha that they would be agreeable to no low tide restriction on works.</p> |
| Dunedin City Council (DCC) | <p>Port Otago has also been in consultation with the DCC since the first beach protection options were considered in 2011.</p> <p>The DCC has been present at a number of stakeholder meetings with Port Otago and the TRBCCC over this time as identified in Appendix I.</p> <p>The DCC planned improvements of the Te Rauone Beach Reserve are dependent on the works proposed in this application to rehabilitate the beach. There has also been discussion of collaboration in regard to providing access through the beach to allow the proposed works to be undertaken.</p> <p>Enterprise Dunedin (DCC's in-house economic development, tourism and marketing agency) has provided a letter in support of the project as attached in Appendix I.</p> |
| Other Community Groups | <p>Te Rauone Incorporated, as the representative of the properties north of Te Rauone Beach and including Perpetual Guardian, has been consulted in regard to the proposed works.</p> <p>Perpetual Guardian has provided a letter in support of the Project on behalf of Te Rauone Incorporated as attached in Appendix I.</p> |

8.1.1 Statutory Acknowledgments

Two applications made under the Marine and Coastal Area Act 2011 are relevant to the proposed area of works. These include applications from:

- Robert and Natalie Karaitiana (application number MAC-01-13-05)
- Te Rūnanga o Ngāi Tahu (application number MAC-01-13-02)

Both groups have been notified of the proposal via Aukaha with a response provided as discussed above in section 8. It is noted that both parties' customary marine title applications have yet to be granted and as such, written permission is not as yet required. Under the Marine and Coastal Area (Takutai Moana) Act 2011 (the MACA Act), resource consent applicants are required to seek the views of MACA applicants only.

8.2 Public notification

Port Otago Ltd is requesting public notification of the project to ensure the community can fully participate in the resource consent process and that all relevant issues are addressed through this.

Port Otago hereby request public notification pursuant to s95(3)(a) of the RMA.

9. Proposed Conditions

A consent authority may impose conditions on the requested consent under section 108 of the RMA.

A list of suggested consent conditions informed by the AEE is provided in Appendix G to assist each council with assessment of the effects of the proposal.

10. Conclusion

Port Otago seeks a coastal permit and land use consent for the works associated with the proposed construction of three rock groynes and the deposition of sand to renourish Te Rauone Beach.

The proposed works are specifically provided for as a Discretionary Activity under the RPC and Restricted Discretionary Activity under the 2GP.

This application has provided an AEE of the proposed rock groyne structures and sand renourishment proposed at Te Rauone Beach. This assessment has shown that the potential adverse effects arising from the activity will be no more than minor (Section 104(1)(a)) and that significant positive effects will arise as a result of the proposal.

An assessment contained in section 6 of this application has also demonstrated the proposal is consistent with the purpose and principles of the RMA and with the objectives and policies of the relevant National and Regional Policy Statements, the RPC and the 2GP (Section 104(1)(b)).

Appendices

Appendix A – Certificate of Title



**RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy**




R. W. Muir
Registrar-General
of Land

Identifier 99423
Land Registration District Otago
Date Issued 03 July 2003

Prior References

OT350/227

| | |
|--------------------------|--|
| Estate | Fee Simple |
| Area | 4.1885 hectares more or less |
| Legal Description | Lot 1 Deposited Plan 6468 |
| Purpose | Local Purpose (coastal protection) Reserve |

Registered Owners

Dunedin City Council

Interests

Subject to the provisions of The Otago Heads Maori Reserve Road Act 1908 as affected by Section 118 of The Native Purposes Act 1931

Subject to Section 59 Land Act 1948

959581.1 SUBJECT TO PART 9 OF THE NGAI TAHU CLAIMS SETTLEMENT ACT 1998 (WHICH PROVIDES FOR CERTAIN DISPOSALS RELATING TO LAND TO WHICH THIS CERTIFICATE OF TITLE RELATES TO BE OFFERED FOR PURCHASE OR LEASE TO TE RUNANGA O NGAI TAHU IN CERTAIN CIRCUMSTANCES) - 21.12.1998 AT 9.13 AM

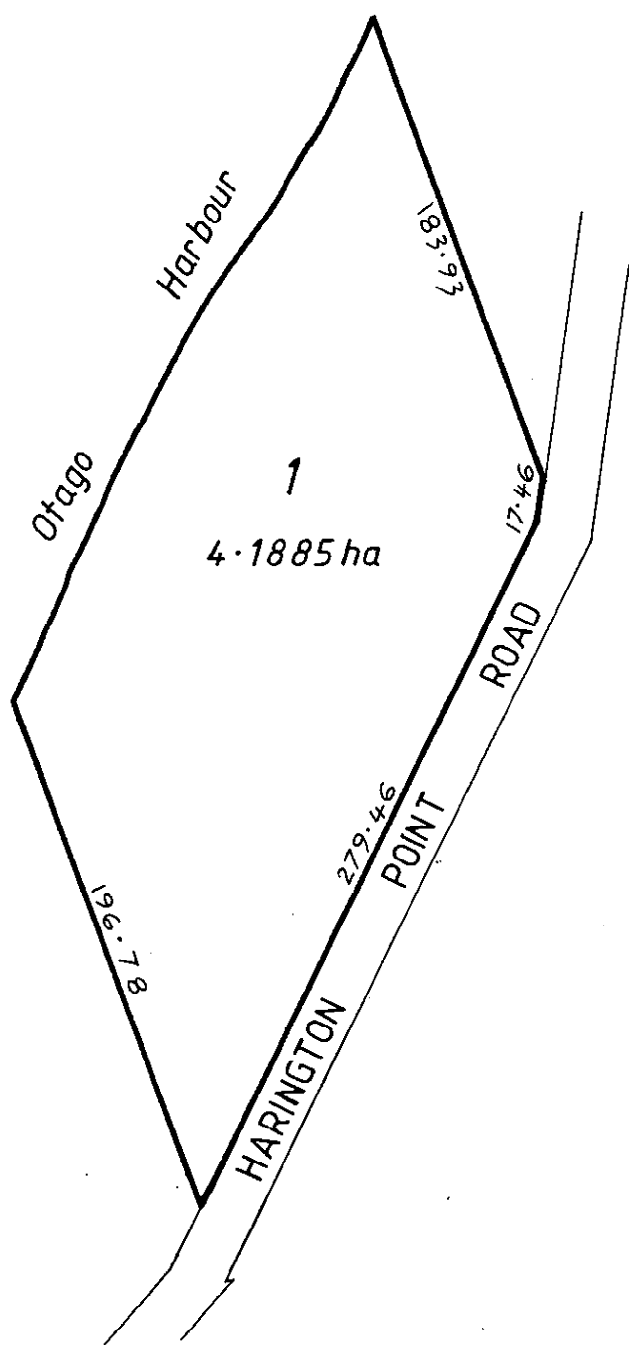
Subject to the Reserves Act 1977

Title Diagram Diagram

Cpv - 01/01.Pigs - 001.22/07/03.10 41



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**RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy**




R. W. Muir
Registrar-General
of Land

Identifier 307226
Land Registration District Otago
Date Issued 22 March 2007

Prior References

OT17C/903

| | |
|--------------------------|------------------------------------|
| Estate | Fee Simple |
| Area | 252 square metres more or less |
| Legal Description | Lot 2 Deposited Plan 375006 |
| Purpose | Local Purpose (Coastal Protection) |

Registered Owners

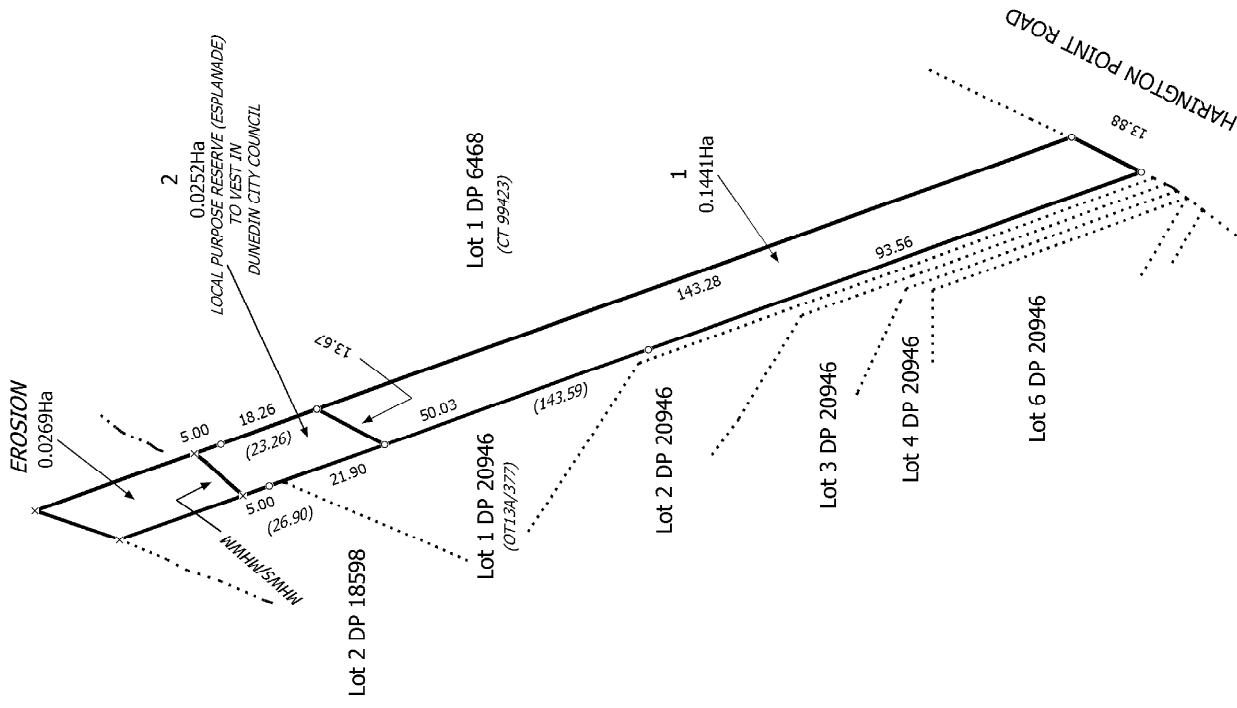
Dunedin City Council

Interests

Subject to the Reserves Act 1977



Diag. A



T 1/1

Digital Title Plan
DP 375006

Deposited on: 22/03/2007

Surveyor: Geoffrey William Bates
Firm: D G Hatfield & Associates (Dunedin)

Lots 1-2 being a Subdivision of Lot 11 DP20345 and Erosion Hereto

Lend District: Otago

Digitally Generated Plan
Generated on: 16/04/2007 08:30am Page 2 of 2



**RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy**




R. W. Muir
Registrar-General
of Land

Identifier 40236
Land Registration District Otago
Date Issued 17 June 2002

Prior References

OT186/22 OT9B/1098

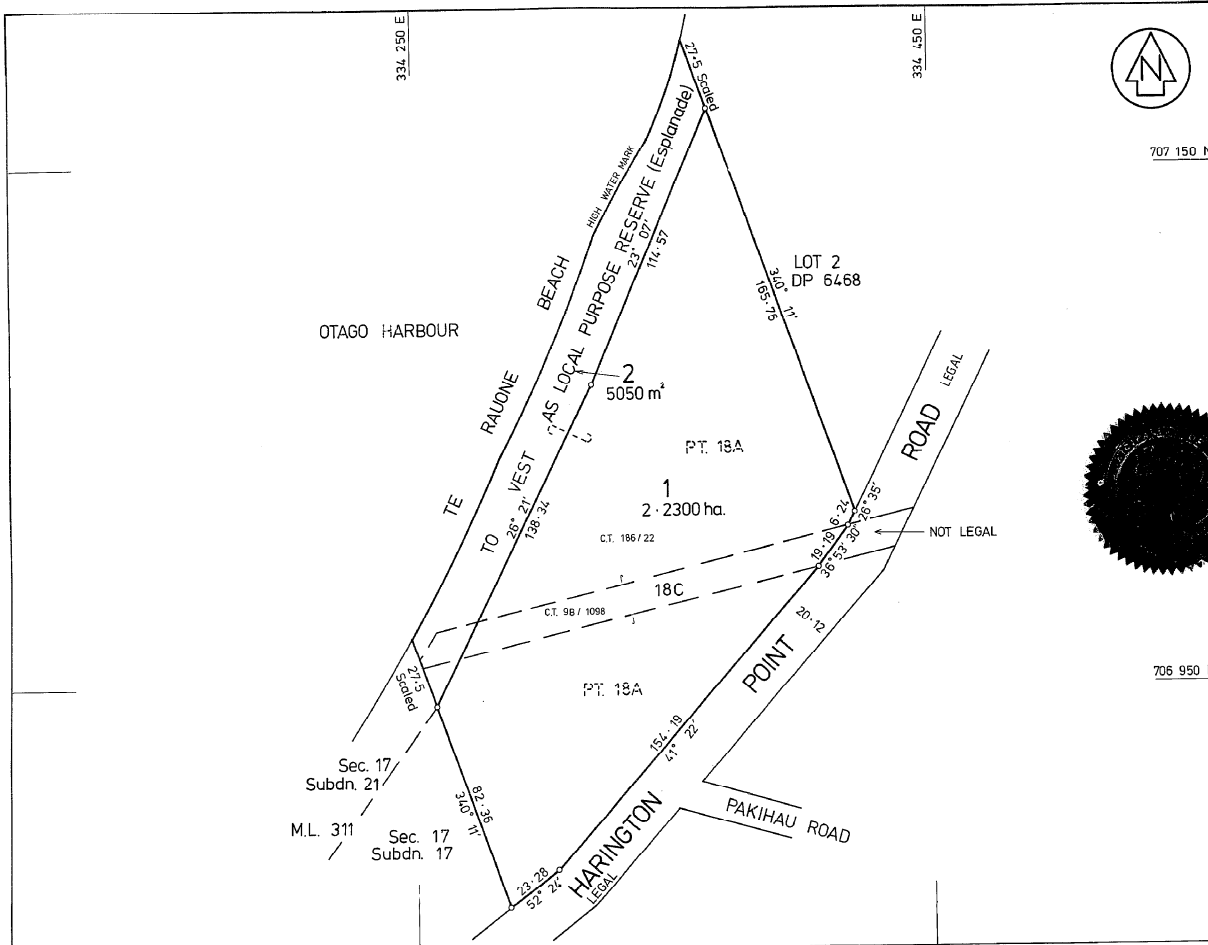
Estate Fee Simple
Area 5050 square metres more or less
Legal Description Lot 2 Deposited Plan 18598
Purpose Local Purpose (Coastal Protection)
Reserve

Registered Owners

Dunedin City Council

Interests

Subject to the Reserves Act 1977



707 150 N

706 950 N

Approved Registered Owners

The Common Seal of the Paparua Trust
[Signature]
 CHIEF MANAGER
 AUTHORIZED SIGNATORY

The Dunedin City Council certifies that:
 (1) This plan of subdivision is approved pursuant to Section 223 of the Local Government Act 1974 by resolution of the said Council passed on the 11th day of August 1983, subject to such conditions as are set out in paragraph 18 hereon;
 (2) This plan is in accordance with the requirements and provisions of the said Council's operative district planning scheme of that date; and that
 (3) The conditions referred to in paragraph (1) hereon are:
 (a) That Lot 2 hereon used in the Dunedin City Council as a Local Purpose Reserve (Esplanade).
 (b) All other conditions on the approved scheme plan have been complied with.

IN WITNESS whereof the Council of the said City of Dunedin has hereunder affixed its official seal and the signature of its duly authorized officer, the Mayor, and the signature of the Town Clerk.

[Signature] Mayor
[Signature] Town Clerk

DATUM Geodetic 1949
 Co-ords from Trig 'A' North Taieri
 700 000 N 300 000 E

| | |
|--------------|----------------------------|
| Total Area | 2.7350 ha |
| Comprised in | C.T. 186/22 & C.T. 9B/1098 |

I, Anthony P. H. H. H. of Dunedin, Registered Surveyor and holder of an annual practicing certificate hereby certify that this plan has been made from surveys executed by me or under my direction, that both plan and survey are correct and have been made in accordance with the regulations under the Surveyors Act 1968.

Dated at Dunedin this 23 day of AUGUST 1983. Signature *[Signature]*

Field Book 2.218 p. 46-49 Traverse Book 2.21 p. 98, 99
 Reference Plans M.L. 166, 311, 337, D.P. 6468 S.O. 2826, 2828, 2669, 13300, 17220
 Examined *[Signature]* 25/11/83

Approved as to Survey
 25/11/83
[Signature] Registered Surveyor

Deposited this 18th day of March 1983
[Signature] Registrar

File 3094
 Received 11.10.83
 Instructions
 DP 18598

LAND DISTRICT OTAGO s.o.r.m. J44/12
 SURVEY BLK. & DIST. II PORTOBELLO
 NZMS 261 SHEET NO. J 44

LOTS 1 & 2 BEING SUBDN OF OTAKOU MAORI RESERVE BLK B
 LOT 18C & PT. LOT 18A

LOCAL AUTHORITY DUNEDIN CITY
 Surveyed by Lambourne & McLean
 Scale 1:1000 Date MARCH 1983

Appendix B - Detailed Design Report

Report

Te Rauone Beach Management Scheme: Detailed Design Report

Prepared for Port Otago Ltd

Prepared by Beca Limited

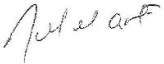

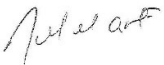
12 March 2020



Revision History

| Revision N° | Prepared By | Description | Date |
|-------------|---------------|---------------------------------------|------------|
| 6 | Jennifer Hart | Updated issue for consent application | 12.03.2020 |
| 5 | Jennifer Hart | Issue for consent application | 20.11.2019 |
| 4 | Jennifer Hart | Updated draft issue | 15.11.2019 |
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Beca 2018 (unless Beca has expressly agreed otherwise with the Client in writing).

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Appendices

Appendix A

Detailed Design / "For Consent" Drawings

1 Introduction

1.1 Purpose and Scope of Report

Port Otago Ltd (POL) has engaged Beca Ltd (Beca) to undertake design of a beach management scheme at Te Rauone Beach.

The purpose of this report is to describe the detailed design for the scheme, including key assumptions and the design approach. It is expected to accompany a resource consent application which will be prepared by POL.

The scope of the report includes:

- The agreed requirements for the beach scheme.
- The design approach for the scheme, including key assumptions, references and inputs.
- A description of the detailed design, and drawings.
- Maintenance and operation considerations, in an outline maintenance and operation plan.

1.2 Site Description

Te Rauone Beach is located on the southern coast of the Otago Harbour, near the harbour entrance at Harington Point (refer to the location map shown in Appendix A, Drawing 3331121-CA-100). The site experiences westerly and west-south-westerly wind waves generated in the harbour as well as northerly wind and swell waves.

The northern section of the shoreline comprises residential development protected by informal rock revetments. The central section is a sandy, low-tide beach backed by low-lying recreational reserve land. The southern section of the beach includes residential development, protected by informal rock revetments adjoining the reserve boundary. The sandy low-tide beach widens and flattens further to the south to form a 10-20m high tide beach. This southernmost end of the beach is accreting.

The existing intertidal beach at the reserve slopes relatively steeply (approximately 1 vertical : 10 horizontal) from Mean High Water Springs to mid-tide level. The beach/seabed then flattens gradually to a subtidal sand flat with a slope of around 1:300 and water depths of approximately 0.2m above Chart Datum to 0.4m below Chart Datum. The subtidal sand flat extends some 200m offshore to the edge of a minor channel. The main harbour channel is located further offshore, 400-500m north-west of the beach.

The most recent topographic foreshore survey (July 2017) is included in Appendix A, Drawing 3331121-CA-102. All levels in this report and the drawings are in terms of Chart Datum (CD), as provided by surveyors Paterson Pitts Group (PPG).

1.3 Background

Te Rauone Beach has a history of sand loss and realignment over the past century, with the northern end retreating landwards while the southern end has built seaward. This appears to be associated with changes to the harbour entrance in the 19th century and the resulting change to sand supply and the wave climate at the beach. The 1930s placement of sand dredged from the harbour channel (Single, 2007; local community commentary 2016-17) appeared to counter the shoreline retreat for a period of time.

A number of coastal studies have been undertaken by Otago Regional Council (ORC), POL and Dunedin City Council (DCC) over the past twenty-five years to investigate the sand loss issue and possible options. A northern headland concept was developed around 2007-2011. It was reviewed by Tonkin & Taylor Ltd for Otago Regional Council, and by Beca for POL. Both reviews found that the concept had limitations.

Following these reviews, POL initiated a refreshed approach to Te Rauone Beach. A stakeholder meeting with Te Rauone Beach Coast Care Committee (TRBCCC) in August 2016 confirmed that the purpose of any beach works is to create a beach amenity (refer to Section 2). The meeting also discussed possible options for providing the beach amenity including rock groynes perpendicular to the shore, offshore breakwaters and/or beach renourishment. TRBCCC preferred the perpendicular rock groynes and beach renourishment approach as being more acceptable to the community in terms of visual impact, cultural acceptability and marine access to the beach, and general similarity to the historic harbour training walls.

Concepts combining rock structures and renourishment were developed for:

- a. The full length of Te Rauone Beach.
- b. The central reserve section of the beach.
- c. The northern and central sections of the beach.

These concepts were based on relatively limited information at the time, which necessitated a number of assumptions (e.g. beach slope, water depth).

A staged version of the “reserve beach” concept (b, above) was agreed as the way forward at a stakeholder meeting in February 2017. The meeting was attended by representatives from ORC, DCC, TRBCCC, POL, coastal geomorphologist Martin Single and coastal engineers from Beca. It was agreed in principle that construction would be followed by monitoring of beach behaviour, and modification of the design of subsequent rock structure(s) and renourishment based on the monitoring results. This approach was preferred over coastal processes modelling, given the limited scale of the structures and the complexities of the wave climate.

The rock groyne and renourishment option (to be constructed in a single stage) was selected by POL in agreement with the Councils in late 2018, based on consultation with the TRBCCC and the wider public over the preceding year. Feedback generally preferred groynes over offshore breakwaters.

DCC intends to upgrade the reserve which adjoins Te Rauone Beach. The reserve upgrade potentially includes carparks and accessways, playground and picnic areas, boardwalks and a maintenance vehicle track (to manage beach access), and dune building and planting landward of the beach. The reserve upgrade, which is presently at an early concept stage, will interface with the proposed beach management works.

This report sets out the detailed design for the proposed Te Rauone beach management scheme, comprising rock groynes and beach renourishment.

2 Scheme Requirements

As noted in Section 1, the objective of the Te Rauone beach management scheme was confirmed with TRBCCC in August 2016, at the outset of the current design process.

The scheme objective agreed with TRBCCC is to provide a beach amenity, with a high tide beach width of at least 5m.

The original requirement was to provide this amenity for the full length of Te Rauone Beach. This was subsequently refined in October 2016 and agreed in February 2017 to focus on the beach seaward of the DCC reserve, which is bordered to the north and south by rock revetments.

Design life is the period past which major maintenance or renewal is likely to be required for an asset. A twenty year design life and 2% Annual Exceedance Probability (AEP) design wave condition have been adopted for the rock structures. This is consistent with the 'public amenity' nature of the project and the pragmatic approach to estimating the design wave condition which has been applied because of data availability, as well as climate change considerations (refer to Section 3.2.1). Remedial work / repair is likely to be required if conditions exceed the 2% AEP design condition. Regular, routine groyne maintenance will be necessary during the design life (refer to Section 5). Regular renourishment (top-up of beach sand) is expected to be required, as recognised at the February 2017 stakeholder meeting.

3 Design Approach

3.1 Approach

The design approach covers three areas:

- Renourished beach profile (cross section).
- Renourished beach and rock structure plan form (layout).
- Rock structure geometry and rock size.

3.1.1 Beach Profile

The design beach profile (cross section) has been determined with reference to both empirical relationships from coastal engineering publications (US Army Corps of Engineers Shore Protection Manual; US Army Corps of Engineers Coastal Engineering Manual; Dean and Dalrymple, 2002; Bruun, 1990) and assessment of beach slope at the southern (accreting) end of Te Rauone Beach. From the 2017 surveys of the southern end of Te Rauone Beach, the mid to upper tidal slope averages 1:20, with the steepest section at 1:8.

The empirical relationships determine the beach slope as a function of the renourishment sediment grain size and the wave climate at the site (e.g. sheltered/protected, or wave height and period). The beach slope achieved becomes flatter as available sediment grain size decreases.

The beach crest level is set 0.5m above Mean High Water Springs (MHWS) to reduce the frequency at which the beach berm is subject to wave action, while giving consideration to efficient use of renourishment material.

3.1.2 Beach Layout

The design approach for the beach layout uses crenulate bay theory to locate the groynes and estimate the renourished beach shape (in plan). Crenulate bay theory was developed by Silvester and Hsu (1997) to describe an equilibrium beach shape in plan form. The beach shape is a function of the incident wave direction and the location of “control points” or hard features which refract the incident waves and anchor the beach. This theory has been used in New Zealand and internationally for design of artificial beaches (e.g. Manukau Harbour, Onehunga foreshore, Singapore).

The incident wave direction has been estimated from a wave energy analysis of prevailing offshore (swell) waves refracted through the harbour entrance and the larger wind waves generated locally in the harbour. This “resultant” or “net” incident wave direction has been checked against the existing coastline alignment, which would be expected to be oriented approximately parallel to the resultant wave crests for the present wave environment. (The existing coastline has rotated some 25° over the past 60 years from a North-South alignment to a more North-East South-West orientation, which is consistent with the estimated resultant wave direction).

3.1.3 Rock Structure Geometry and Armour

The rock structures have been designed based on The Rock Manual (CIRIA, CUR, 2007). The Rock Manual provides guidance on geometry (e.g. crest width, side slopes) and rock sizing. The crest height of the rock groynes has been determined considering the renourished beach profile, efficient use of rock and visual impact. The groyne crest level at the landward end is 0.5m above the renourished beach profile to provide containment of the renourishment material. The crest level at the seaward end of the groynes is set at Mean Sea Level (MSL) to reduce the visual impact of the groynes.

Rock armour has been sized using the van de Meer formula and checked against the Hudson formula (both as set out in The Rock Manual) for 2% Annual Exceedance Probability (AEP) refracted offshore waves and harbour-generated wind waves. Refer to Section 3.2.1 for design wave information.

The seaward end of the rock groynes will be in approximately 2-2.5m of water at MHWS based on the July 2017 survey. The depth-limited wave for a MHWS tide level is estimated to have a significantly lower probability (<0.01%) than the 2% AEP design condition.

3.2 Key Inputs and Assumptions

3.2.1 Environmental Information

The key inputs and assumptions for the detailed design are those describing the environment:

- Topography and bathymetry are taken from the July 2017 PPG beach and nearshore survey (refer to Appendix A, Drawing 3331121-CA-102). The topographic and bathymetric surveys will need to be repeated prior to procurement and construction so that levels can be confirmed, as beach changes will continue during the consenting period.
- Tide levels are the LINZ secondary port tide levels for Spit Wharf (LINZ, 2019), on the northern side of the Otago harbour, opposite Te Rauone Beach. These are given in Table 1.

Table 1- Spit Wharf tide levels (LINZ)

| Tide Level | Elevation above Chart Datum (m) |
|-------------------------|---------------------------------|
| Mean High Water Springs | 2.00 |
| Mean High Water Neaps | 1.70 |
| Mean Sea Level | 1.00 |
| Mean Low Water Neaps | 0.40 |
| Mean Low Water Springs | 0.10 |

- An allowance of 0.1m has been made for sea level rise during the 20 year groyne life based on the current Ministry for the Environment guidance (2017). The scenarios for representative concentration pathways, NZ RCP 4.5M (intermediate-low emissions scenario) and NZ RCP 8.5M (continuing high emissions scenario), give relative sea level rise between 2020 and 2040 of 0.11-0.12m. Sea level rise guidance will need be reviewed around 2035, leading up to the end of the structures' design life, with any revisions to the design incorporated in the end-of-life major maintenance. This provides a more cost-effective approach than providing initially for a longer sea level rise horizon, noting the continued refinement of climate change modelling and guidance. At some future point, potentially in 30+ years as the accuracy of long term sea level rise projections improves, consideration will need to be given to the long term scheme viability.
- Wind climate information has been sourced from the 2003-2008 Taieri Head wind records. Design wind speed for harbour wind wave generation has been taken from NZS 1170.2 2011 Structural design actions Part 2 Wind actions.
- There is no modelled wave data or combined probability extreme event wave / water level information available for the Te Rauone site. Design wave conditions at the site were calculated as follows:
 - Hindcast north-easterly and easterly offshore wave conditions, corresponding to a 2% AEP, were refracted through the harbour entrance to the site.
 - Harbour-generated wind waves at the site (westerly direction, corresponding to longest all-tide fetch length) were calculated using a JONSWAP spectrum for a fetch-limited condition with the V50 (2% AEP) wind speed from NZS 1170.2.

Table 2 summarises the design wave conditions used for the rock groynes.

Table 2- Design wave conditions at the site

| Wave condition | Significant wave height, Hs (m) | Peak period, Tp (s) |
|--|---------------------------------|---------------------|
| Refracted offshore wave (2% AEP offshore wave conditions) | 1.1 | 6 |
| Harbour wind wave (2% AEP wind speed) | 1.2 | 3 |

- Available reports (Mulgor, 2008; Pullar and Single, 2009) indicate existing long period vessel wake of up to 0.4m-0.5m in height, and apparently 40s – 200s period, which may increase by 10-15% with larger vessels entering the harbour. These wake waves are less onerous for groyne design than the design wave conditions.
- The existing rock revetments at the northern and southern ends of the site appeared to be in fair to good condition from visual, non-intrusive observations of the structures between April 2017 and February 2020. These structures are understood not to have resource consents. The existing northern revetment is shown in the sketch in Drawing 3331121-SK-003. From personal communication with the local community it is understood that:
 - The northern revetment was progressively constructed from around 1990 onwards.
 - The older section of revetment is located around the mid-point of the northern “promontory” formed by the revetment. Boards and tractor tyres were initially placed on the foreshore. The boards were subsequently removed and large rock (approx. 1m diameter) was placed along the foreshore. Smaller rock (typically up to approximately 0.5m diameter) was placed towards the top of the revetment. This older section of the revetment has been stable with minimal maintenance required over the past 30 years.
 - The revetment was progressively extended to the southeast, as the revetment was outflanked over time. The southeastern section typically uses smaller rock. It has been topped up and extended approximately every 5 years. The most recent extension appears to have been in early 2015.
 - The revetment largely consists of rock from local quarries, with some recycled concrete that varies in size and shape. It appears that rock size and availability, and placement of approximately a 1:2 slope have been the primary considerations for top up materials and methods.
 - The revetment was constructed by an experienced marine works contractor rather than being formally engineered; it is typical of such structures, addressing retreat of the foreshore at the immediate location of the revetment with progressive extension to address outflanking as noted above. The crest of the revetment varies between approximately 3.5m CD and 4.7m CD (1.5m to 2.7m above MHWS).

As with many legacy coastal structures, the existing revetment reflects the nature of its development, which is outlined above and is less regular (in terms of rock size, revetment slope and material) than if a formally designed and constructed revetment were installed today. Local resident reports and comparison of recent site photographs indicate that the older section of revetment has remained stable and has limited the retreat of the foreshore at this location.
- April 2017 scala penetrometer tests at the site provided geotechnical information.
- A renourishment sediment grain size of 0.23mm has been adopted based on the samples from the Main Claim channel area. This is similar to the native sediment size of 0.2mm on Te Rauone Beach. It is finer than the sediment typically used for beach renourishment (0.5mm-1.5mm) and will produce a flatter beach profile than is normally the case with artificial beaches.

4 Detailed Design

The detailed design is shown in the drawings in Appendix A and described in this section. As noted in Section 3.2.1, updated surveys will be required before procurement and construction. The detailed design will be updated and confirmed based on these surveys and provided to the ORC and DCC for information prior to construction.

4.1 Renourishment Beach Profile

The beach renourishment profile comprises:

- A beach berm at 2.5m CD, 0.5m above Mean High Water Springs, and a minimum of 5m wide.
- A typical beach slope of 1:20 from the berm to the present seabed level, typically at 0.1m CD to -0.3m CD.

The beach slope is driven by the available 0.23mm sediment grain size and results in a relatively wide beach profile (refer to Appendix A, Drawing 3331121-CA-105).

The landward side of the beach would connect with the dunes proposed in DCC's reserve upgrade concept. The planted dunes would provide protection to the reserve and an enhanced beach system with greater resilience to extreme erosion events, as well as capture of windblown sand. In the interim, pending implementation of the DCC reserve upgrade, the edge of the beach will be graded between the renourished beach and in situ ground. The grading and natural colonisation of the landward edge of the berm by existing vegetation (e.g. *muehlenbeckia*) will help to provide a more resilient buffer against wave run-up, erosion and windblown sand.

The initial beach renourishment is estimated as 19,000m³ (measured on the beach), based on the 2017 PPG survey. It is suggested that an additional allowance of 7,500 to 15,000 m³ (measured on the beach) is made for erosion over a two to five year period until construction.

Over time, the actual profile of the beaches will vary from the design profile as it is acted on by wave events, wake and tides, with potential for minor steepening at the northern, curved end of the beaches. Storm events may result in flattening of the slope and removal of material offshore. Onshore wind conditions have the potential to carry sand landward from the beach onto the reserve, where it will be trapped by the existing vegetation. This windblown sand remains part of the overall system, contributing to any dune created as part of the future reserve upgrade. Sand from the renourished beaches that is removed offshore or blown landward will be replaced by material recycled from the accreting area south of the site, subject to monitoring, and by renourishment using sand from channel dredging or similar sources of suitable grain size and quality (refer to Section 5). Beach monitoring will be used to estimate the frequency and volume of recycling and renourishment.

4.2 Beach Layout

The proposed beach layout is shown in Appendix A, Drawing 3331121-CA-103. It is based on the beach profiles described above. The length and orientation of the rock structures are governed by the requirement for a minimum high tide beach berm width of 5m.

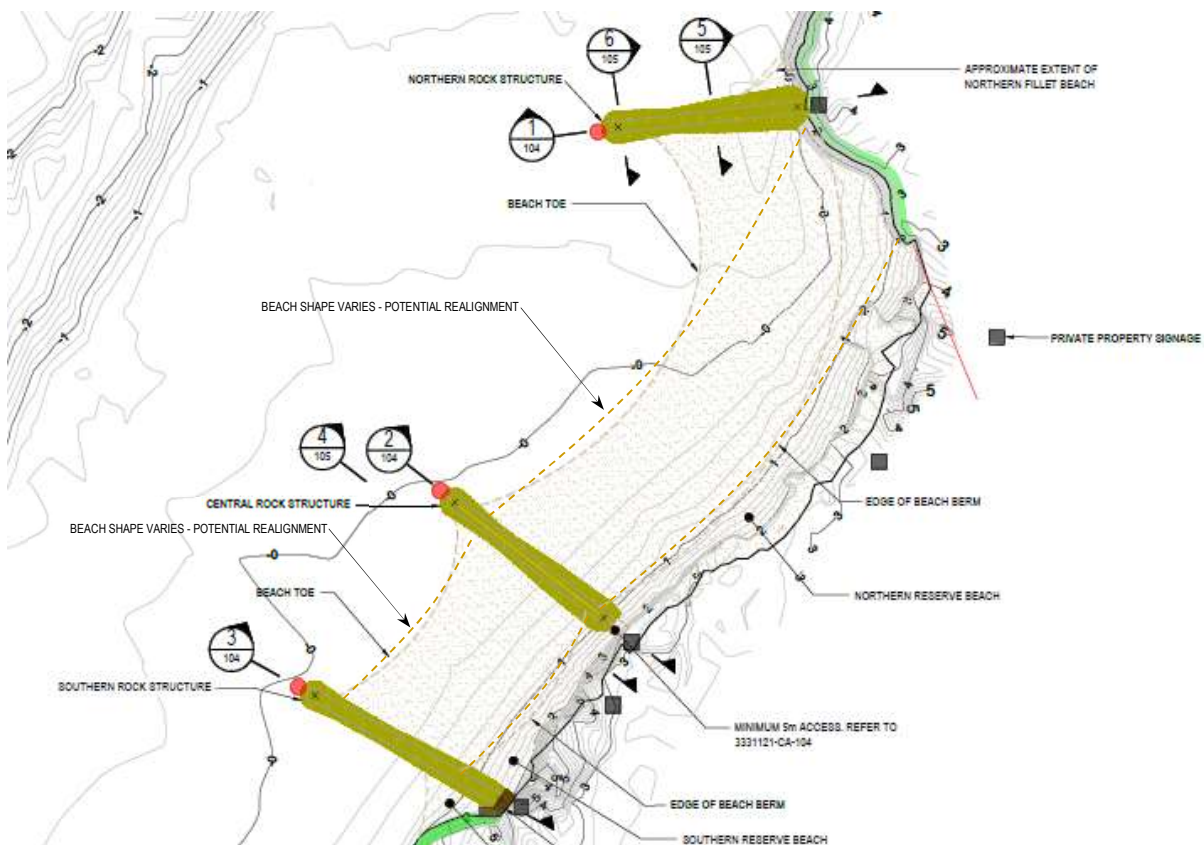
Groynes

The beach layout has been derived using crenulate bay theory (refer Section 3.1.2). It comprises three groynes extending approximately 70-80m from the existing shoreline, with two beaches contained between the groynes. The groynes are located immediately north and south of the reserve, with a central groyne roughly mid-way along the existing reserve beach.

Variation in beach shape

The shape of the beaches between the structures will alter from the plan forms shown in Appendix A depending on wave conditions (e.g. sediment will move to the northern end of the beaches under south westerly waves, and to the southern end of the beaches under northerly wave conditions). Figure 1 shows both the design plan form and a potential realignment. Relocation of sediment within the beaches (e.g. from the northern or southern end of a beach to the centre of a beach) would be a practical means of addressing this where the berms become reduced in width or elevation.

Figure 1: Beach shape



Downcoast effects

It is proposed that downcoast effects immediately south of the scheme be addressed by:

- Providing a sand-permeable seaward section of the southern groyne (refer to Section 4.1.3) to allow for limited movement of sand past the structure, helping to feed the downcoast beach. As a result, the new central beach will also require regular inputs from recycling, and renourishment over time.
- Initial renourishment of the southern fillet beach, south of the southern groyne and adjacent to the existing rock revetment.

- Over time, additional sand may be required to replace renourishment lost from the system through on-going natural processes. This will be determined by beach monitoring (refer to Section 5), with sand either being recycled from the accreting southern end of the beach or new sand from channel dredging being placed on the renourished beaches. Any new sand will be of suitable grain size and quality.

These measures provide mitigation for potential effects of the scheme on the existing rock revetments located immediately south of the scheme.

Clearance

It is noted that the foreshore of the main DCC reserve site will require clearance of debris (e.g. tree stumps, loose rubble) and some vegetation prior to the beach management works. Separately, DCC plans to upgrade the reserve and is understood to be responsible for addressing any landside material, works, etc in the reserve.

4.3 Rock Groynes

The 70-80m long groynes (Appendix A, Drawings 3331121-CA-104 and -105) comprise an armour layer, with a nominal mean diameter (Dn50) of 0.5m (mean rock mass of 0.35t).

The landward 45-50m of the structures includes a core of smaller rock with a Dn50 of approximately 0.2m. The rock is sized as an underlayer, so that it does not migrate through the armour layer. This replaces the traditional fine core material. The size of the armour and height of the structures means that it is not efficient to use both an underlayer and traditional core. The seaward section of the rock structures uses armour rock without the core material, to aid constructability and reduce costs.

A heavy duty geotextile such as BIDIM A64 is placed below and through the groynes to reduce migration of sand through them (either from the renourished beach or from the underlying native sand). A configuration for the placement of the geotextile is outlined in Drawing 3331121-CA-105. The seaward section of the southern groyne comprises armour rock, with geotextile placed only below the groyne. This is to allow movement of sand through the structure to feed the southern beach and assist in mitigating downcoast effects, as noted previously.

The northern groyne will connect with the existing northern revetment (refer also to Drawing 3331121-CA-104 and Section 3.2.1). It is anticipated that the connection works, including localised revetment reconstruction, will be directed on site by a senior marine engineer. The works at the connection location and extending approximately 5m either side of the northern groyne are expected to proceed generally as follows:

- Existing large rock elements will be removed from the mid/upper revetment.
- The revetment face will be shaped to a regular 1:2 slope with the addition of new underlayer rock.
- The landward end of the new groyne will be placed against the revetment face.
- New armour rock and existing large rock will be placed on groyne and revetment at the connection to give an interlocked finish with a 1:2 slope, transitioning into the existing revetment on both sides of the groyne.

The works above, together with the safety, monitoring and management measures set out in Sections 4.4 and 5, provide a pragmatic approach to installing the northern groyne noting the reported stability of this section of the revetment and practical considerations. This is consistent with typical industry practice when connecting a new element to an existing revetment. The NZS3910 construction contract will include Engineer to Contract and Engineer's Representative roles for management of the contract, as well as hold points for inspections of the works and certification of practical completion.

Permission has been obtained from the relevant landowner/resident for the groyne-revetment connection (refer to overarching Assessment of Environmental Effects).

As shown in the drawings (Appendix A), the central groyne has “walk through” access at its landward end. This provides for passage between the northern and southern reserve beaches. The southern groyne ends at the existing dunes with an allowance for a future boardwalk and steps over the groyne to provide low tide access to the foreshore and beach further south.

The landward crest of the rock structures is at 3m CD, providing containment to the renourished beach berm. The landward section of the rock structures has been designed with a crest slope of 1:20, parallel to the renourished beach profile. This is to reduce the rock quantity required and the visual impact of the rock structures. The side slopes of the rock structures are 1:1.75 along the trunk of the structures. At the seaward head of the structures, the side slope flattens to 1:2.5 to provide greater stability.

The toe of the rock structures has been designed as a buried toe detail to reduce the quantity of material required. This is shown in the drawings. An experienced marine contractor with appropriate plant and construction methodology will be required for these works which will be undertaken below low water.

The volume of armour, including the toe, and of underlayer rock is approximately 2,500 to 3,000m³ (bulk in situ measure, based on the 2017 survey). It would be prudent to allow an additional 750m³ for localised revetment reconstruction works at the connection with the proposed northern groyne. Additionally, 450 to 900m³ has been allowed for potential beach and seabed lowering over a two to five year period until construction. This yields a rock volume of 3,700 to 4,700m³ (bulk in situ measure).

4.4 Safety in Design

Safety in design reviews were completed as part of the design process. These identified the following matters to be addressed during design and documentation:

- Inclusion of signage to alert beach users to potential vessel wake and associated waves/ currents at the beach; and also to prohibit access to the rock structures for safety reasons.
- Consideration of high tide access along the beach past the rock groynes, noting that existing rock seawalls affect high tide access at the northern and southern sections of the reserve beach.
- Identification of rock groyne structures to boating users including markers and inclusion in charts (see below for latter).
- Clearance of debris from the foreshore, noting that the beach management project is located on the foreshore and extends seaward while DCC is responsible for landside works in the reserve.
- Provision should be made to support procurement of an experienced marine contractor.
- Pricing and contract documents to identify site hazards (marine conditions including wind, tides, waves, vessel wake/surge and selection of appropriate weather windows for groyne/revetment connection; soft sediments; existing northern revetment including unforeseen conditions and materials; Harington Point Road traffic; public use of reserve, beach and adjacent harbour; safe access for delivery of sand to the beach) and require the contractor to provide a Site Specific Safety Plan that addresses these.
- LINZ Hydrographic Office to be advised of scheme for inclusion in nautical charts, Notices to Mariners and (during construction) temporary Notices to Mariners.

The first four items are covered in the drawings (Appendix A). The remaining three items are to be addressed in the contract documents.

4.5 Construction

The construction methodology will be determined by the contractor. In general terms the following may be anticipated:

- A contractor's site establishment and storage area will be required. The temporary establishment and storage area is expected to be located on an adjacent private property. Site offices, plant, materials and staff parking will be located in this area. Minimal stockpiling of rock is anticipated. The general layout of the temporary construction area is indicated in Drawing 3331121-SK-002.
- During the construction period, access to the beach and foreshore, site establishment area and site accessways will temporarily be restricted to the contractor, as generally indicated in Drawing 3331121-SK-002, in order to safeguard the public and the contractor's staff. This will be achieved using temporary site fencing and signage. The temporary accessways are expected to comprise a running course of clean AP65 aggregate (approximately 1500m² area and 300m³ in situ volume) placed over geogrid/geofabric, with minor grading of the sandy backshore at the beach accesses to provide a smooth transition between land and beach (up to 400m² area and 300m³ in situ volume of grading).
- Following site establishment and site clearance, it is expected that the rock groynes will be constructed sequentially from north to south. Renourishment can proceed once the flanking groynes are complete e.g. the northern beach will be renourished once the northern and central groynes are in place.
- Groyne construction may be land-based, with temporary rock or sand access bunds extending seaward from the shoreline for groyne construction, or marine-based using barges and workboats, or a combination of these. Preparation of the beach for groyne construction, and subsequent placement of geotextile and rock, will be carried out by land-based or barge-based excavator/s to form the groynes.
- Rock is expected to be provided from a local Dunedin quarry, and trucked via Portobello Rd / Harington Point Rd to the site. Truck movements may be up to 11 movements per day in each direction (approximately two to three per hour in total). A temporary traffic management plan will be in place for the construction traffic.
- The Assessment of Environmental Effects describes sand supply and placement for the project. Key points are:
 - Sand will be dredged under the existing consent from the Main Claim location on Harington Bend. A submersible suction dredge head and pump will be mounted on the backhoe dredge, Takutai, to dredge the sand from the channel. Takutai will sit on its spuds (piles lowered and raised to position the dredge) on the port side of the channel and will also have anchors deployed (by the work boat Kapu) with marker buoys.
 - The sand/water mixture will be pumped ashore via a flexible hose and discharged onto the beach. The hose outlet will be progressively moved along the beach, creating a series of "deltas" or using a grid of sand bunds to encourage settling. The sand falls out of suspension rapidly onto the foreshore, with the seawater returning to the harbour. The deposited sand will be graded into the general form of the new beach using land-based plant (e.g. bulldozer) and will be re-shaped by natural processes over the following weeks to create the renourished beach.
 - Some land-based renourishment may be required initially to provide a sand base before the pumped renourishment starts. This might involve some 1200m³ of sand (approximately 200 inbound truck movements) be brought to the site via Portobello Rd / Harington Point Rd from the Dunedin City Wharf. These traffic movements will also be covered by the temporary traffic management plan.
- Disestablishment, including removal of temporary accesses, site offices, plant and any surplus materials and reinstatement of the contractor's site area, will be completed at the end of construction.
- The construction is expected to continue five to six days per week and take some six to eight months to complete, depending on weather and marine conditions, downtime etc.

5 Outline Maintenance & Operation Plan

The Outline Maintenance & Operation Plan for the scheme is set out below. The formal Maintenance & Operation Plan, including as built drawings, will be prepared and submitted to ORC following completion of construction.

The Plan will be held by POL. It will be reviewed annually for the first three years, and on a five yearly basis thereafter.

POL will be responsible for monitoring, inspection and maintenance of the groynes and renourishment.

The post-construction monitoring and inspection regime comprises:

- Quarterly beach and nearshore surveys for the first year after construction, from 150m north of the northern groyne to the foreshore just north of the Pakihau Rd/ Harington Point Rd intersection (i.e. approximately 200m south of the southern groyne). The nearshore surveys will extend 50m seaward of the seaward end of the groynes.
- Annual beach and nearshore surveys for the following two years (extent as above), with monitoring then re-assessed with a view to reducing the frequency, depending on beach performance. These surveys will cover the beach extent as above.
- Annual inspections of the rock groynes, markers and signs for the first three years then re-assessed with a view to reducing the frequency, depending on the performance of these items.
- Post-storm inspection of the groynes and renourishment following significant events (i.e. events with 10% or less AEP).
- Annual surveys of water depths at Wellers Rock jetty for the first three years then re-assessed with a view to reducing the frequency, depending on water depth trends.
- Real-time community feedback via the TRBCCC Chair on beach and groyne condition.

Maintenance requirements, the extent and frequency of which will be confirmed using the above monitoring and inspections, are expected to include:

- Relocation of sand within each crenulate beach, between the groynes. This may be on a two to five yearly frequency and after significant storm events.
- As determined by beach monitoring, sand may be recycled from the accreting southern end of the beach to the renourished beaches. The objective is to relocate the sand before it has the opportunity to be moved further south to the Wellers rock jetty area. This may be on a two to five yearly frequency and after significant storm events.
- Renourishment of the beaches using new sand sourced from entrance channel dredging or similar. This may be on a five to ten yearly frequency and after significant storm events.
- The above sand maintenance provides renourishment of the beach face and berm including topping up the beach berm at the landward end of the groynes to manage potential lowering.
- Rock structure maintenance, for example restoring the crest height and side slopes following storm damage and replacing degraded/fractured armour rock with new armour. This may be on a five to ten yearly frequency and after significant storm events. More substantial reconstruction would be expected to be required for storm events exceeding the design conditions (i.e. 2% AEP events).
- During maintenance, public access to some areas will be limited for the safety of the public and maintenance workers. These areas are expected to include the vehicle access track, the groynes (which are prohibited to the public at all times), and the relevant sections of beach. The majority of the reserve including the playground and pedestrian access will remain open to the public. Temporary fencing and signage will be installed to manage access during maintenance.

6 References

Bruun, P, Port Engineering, 1990.

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Dean R and Dalrymple, Coastal Processes with Engineering Applications, 2002.

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LINZ, Secondary Ports Table, <https://www.linz.govt.nz/sea/tides/tide-predictions>, 2019.

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NZS 1170.2 2011 Structural design actions Part 2 Wind actions, 2011.

Pullar A and Single M, Vessel effects as a result of a deeper channel in the Lower Otago Harbour, 2009.

Silvester, R and Hsu, J. Coastal Stabilisation, 1997.

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Appendix A

Detailed Design / “For
Consent” Drawings





▪ CIVIL ENGINEERING
 Project No 3331121

TE RAUONE BEACH MANAGEMENT SCHEME

COVER SHEET AND DRAWING LIST

Prepared for
 PORT OTAGO LTD

By
 Beca

10 MARCH 2020

| DRAWING LIST | | |
|----------------|-----|--|
| DRAWING NO. | REV | DRAWING TITLE |
| 3331121-CA-100 | E | COVER SHEET AND DRAWING LIST |
| 3331121-CA-102 | F | BEACH SURVEY JULY 2017 PATTERSON PITTS GROUP |
| 3331121-CA-103 | G | GENERAL ARRANGEMENT PLAN |
| 3331121-CA-104 | F | ROCK STRUCTURES LONGITUDINAL SECTIONS |
| 3331121-CA-105 | F | ROCK STRUCTURES TYPICAL CROSS SECTIONS |
| 3331121-CA-106 | D | ROCK ARMOUR AND BEACH RENOURISHMENT SPECIFICATIONS |
| 3331121-CA-115 | C | HISTORIC GROVNE LOCATION PLAN |
| 3331121-SK-002 | B | TEMPORARY CONSTRUCTION AREAS AND ACCESS |
| 3331121-SK-003 | A | EXISTING NORTHERN REVETMENT |

DETAILED DESIGN
 NOT FOR CONSTRUCTION

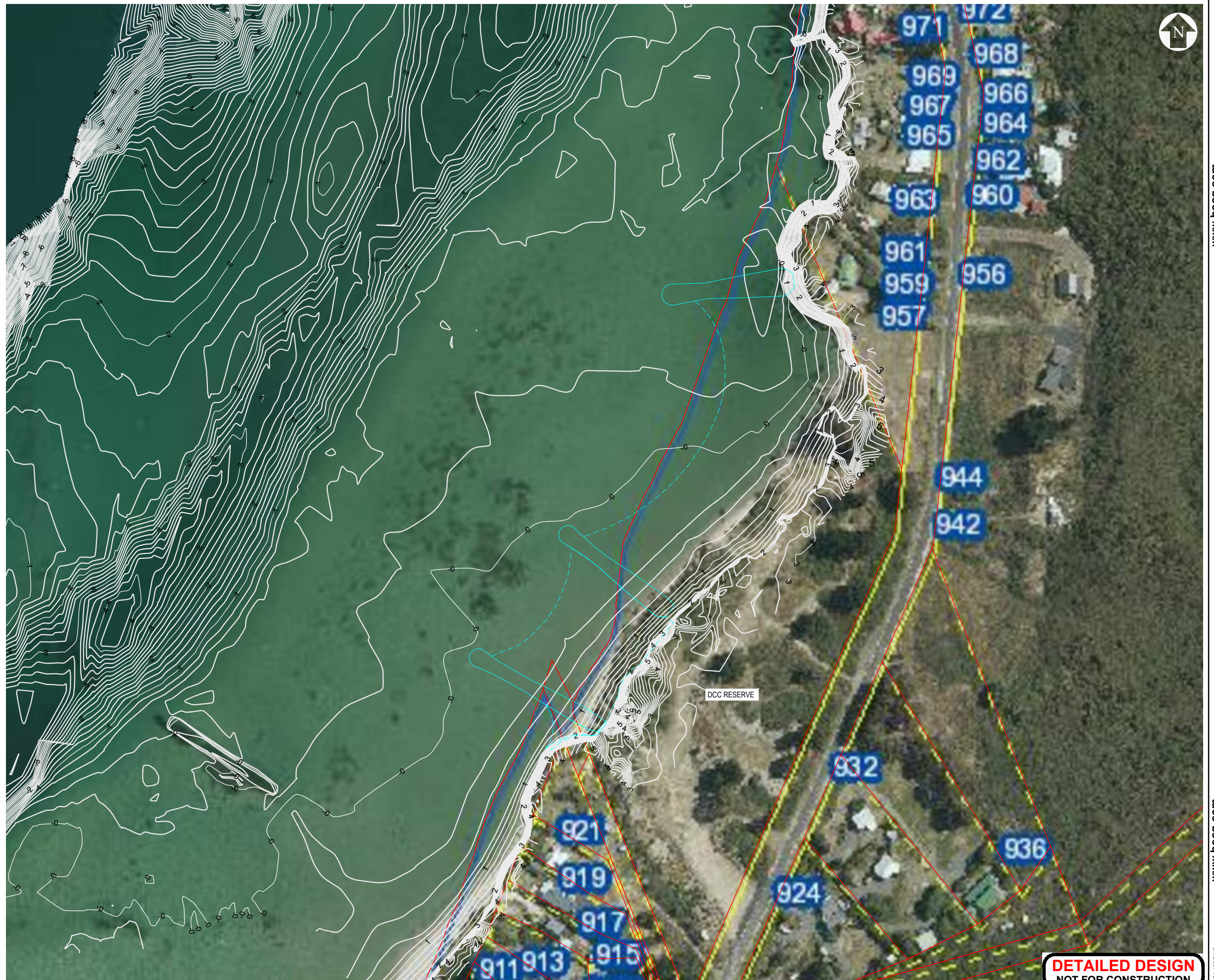
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| Drawing No. | 3331121-CA-100 | Rev. | E |
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NOTES:

1. SURVEY DRAWING IN CHART DATUM.
2. APPROXIMATE TIDE LEVELS AT SPIT WHARF OPPOSITE TE RAUONE BEACH FROM LINZ.
3. COORDINATES ARE IN NZTM.
4. ALL MEASUREMENTS HAVE BEEN MADE USING RTK GPS METHODOLOGY.

| TIDE | TIDE LEVELS (CD) (SPIT WHARF) |
|------|----------------------------------|
| MHWS | 2m |
| MSL | 1.0m |
| MLWS | 0.1m |

-  FOOTPRINT OF WORKS
-  PROPERTY BOUNDARY




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| No. | Revision | By | Chk | Appd | Date |
|-----|----------------------------|------|-----|------|----------|
| F | UPDATED CONSENTING ISSUE | CVDM | JHH | JHH | 06.03.20 |
| E | REISSUED DETAILED DESIGN | MA | JHH | JHH | 19.04.19 |
| D | REISSUED DETAILED DESIGN | GP | JHH | JHH | 22.03.19 |
| C | ISSUED FOR DETAILED DESIGN | RS | IG | JHH | 14.12.18 |
| B | PRELIMINARY DESIGN | CGK | JHH | RC | 23.08.17 |

Drawing Originator:



| Original Scale (A1) | Design | RS/JHH | 22.03.19 | Approved For Construction* |
|---------------------|-----------------|--------|----------|----------------------------|
| 1: 1000 | Drawn | CGK/GP | 22.03.19 | |
| Reduced Scale (A3) | Design Verifier | KS/IG | 22.03.19 | |
| 1: 2000 | Design Check | SS | 09.03.20 | Date |

* Refer to Revision 1 for Original Signature

Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: BEACH SURVEY JULY 2017

PATERSON PITTS GROUP

Discipline: CIVIL ENGINEERING

Drawing No: 3331121-CA-102








Rev: F

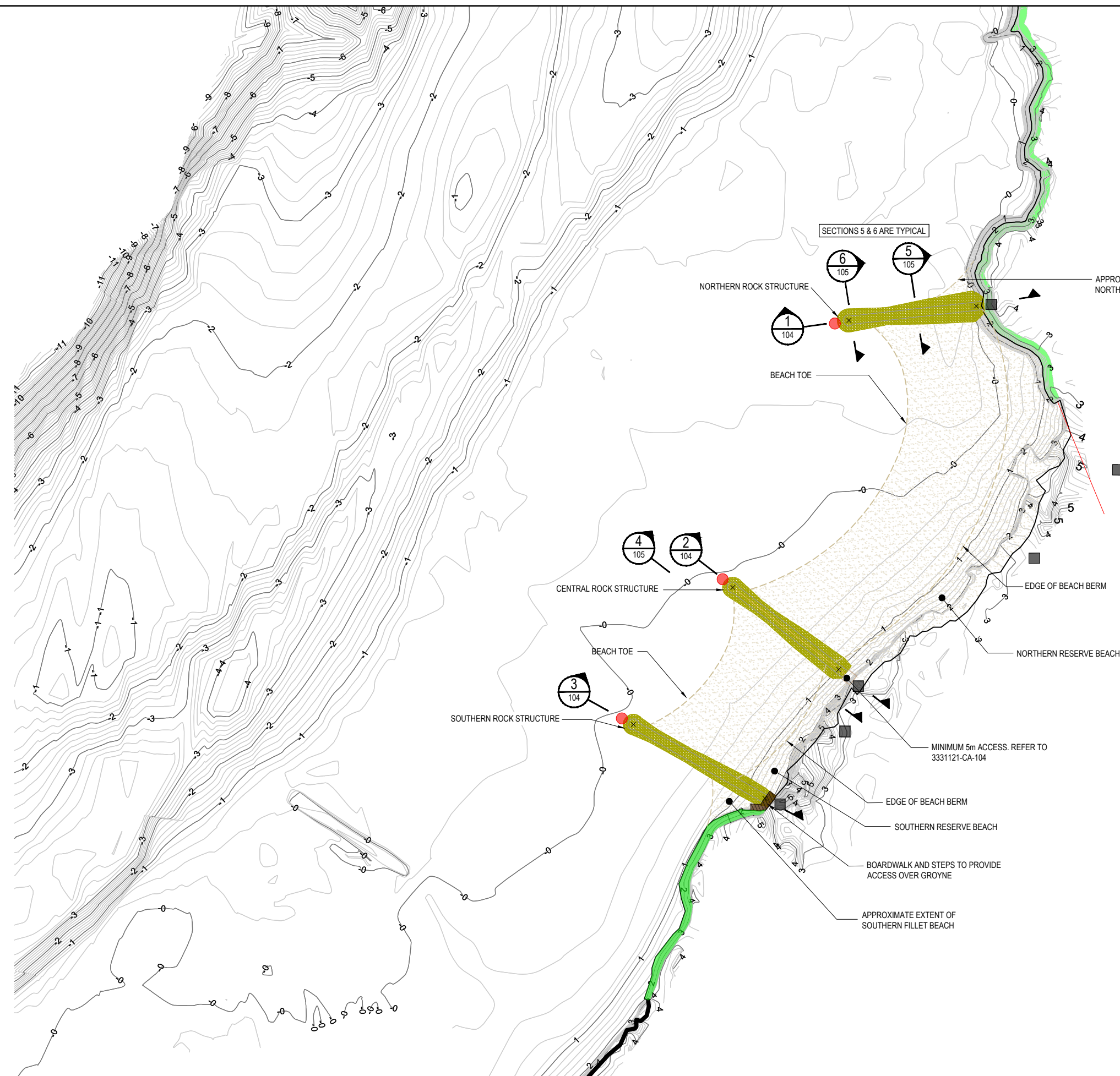
DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

- LEVELS BASED ON JULY 2017 PPG SURVEY - TO CHART DATUM. CO ORDINATES TO NZTM 2000.
- THE WAVE CLIMATE AT THE SITE WILL RESULT IN SAND MOVEMENT WITHIN AND BETWEEN EMBAYMENTS (BEACHES). THIS WILL CAUSE VARIATION IN BEACH PLAN FORMS OVER TIME. RELOCATION OF SAND WITHIN EMBANKMENTS (BEACHES), RECYCLING OF SAND FROM ACCRETION AREA SOUTH OF SITE, AND/OR INTERMITTENT RE-NOURISHMENT WILL BE REQUIRED.
- THE SCHEME WILL BE MONITORED FOLLOWING COMPLETION TO CONFIRM THE FREQUENCY AND VOLUME OF SAND RELOCATION, RECYCLING AND/OR RENOURISHMENT.
- FORESHORE SITE TO BE CLEARED OF DEBRIS PRIOR TO COMMENCEMENT OF BEACH WORKS. DEBRIS TO BE DISPOSED OF TO AN APPROVED LANDFILL.
- SIGNAGE ADVISING OF SURGE AND WAKE TO BE SUPPLIED AND INSTALLED AT ENTRY POINTS TO BEACH. BIDIRECTIONAL SIGNAGE ADVISING THAT ACCESS TO ROCK STRUCTURES IS PROHIBITED TO BE INCLUDED AT LANDWARD END OF EACH ROCK STRUCTURE. ALL SIGNAGE TO BE NO GREATER THAN 0.25m² FACE AREA PER SIDE AND IN ACCORDANCE WITH DCC DUNEDIN SIGN GUIDELINES.
- EASTERN EXTENT OF BEACHES ESTIMATED FROM FEBRUARY 2019 EDGE OF BEACH SURVEY BY PPG.
- BATHYMETRIC AND TOPOGRAPHIC SURVEY TO BE UNDERTAKEN AND USED TO CONFIRM/UPDATE DESIGN PRIOR TO PROCUREMENT AND CONSTRUCTION.

LEGEND:

-  PROPOSED BEACH RENOURISHMENT
-  PROPOSED ROCK STRUCTURE
-  PROPOSED MARKER
-  SETOUT POINT
-  EXISTING ROCK REVETMENT
-  PROPOSED SIGNAGE
-  PROPERTY BOUNDARY



| SETOUT TABLE | | |
|-------------------------|--------------|--------------|
| NORTHERN ROCK STRUCTURE | | |
| ROUNDHEAD CENTRE | 1423225.28mE | 4926502.68mN |
| ROOT CENTRELINE | 1423286.51mE | 4926509.60mN |
| CENTRAL ROCK STRUCTURE | | |
| ROUNDHEAD CENTRE | 1423169.49mE | 4926374.35mN |
| ROOT CENTRELINE | 1423220.43mE | 4926335.05mN |
| SOUTHERN ROCK STRUCTURE | | |
| ROUNDHEAD CENTRE | 1423121.75mE | 4926308.54mN |
| ROOT CENTRELINE | 1423184.93mE | 4926273.02mN |

| | | | | | |
|-----|------------------------------|------|-----|------|----------|
| G | UPDATED CONSENTING ISSUE | CVDM | JHH | JHH | 06.03.20 |
| F | REISSUED DETAILED DESIGN | MA | JHH | JHH | 19.04.19 |
| E | REISSUED DETAILED DESIGN | GP | JHH | JHH | 22.03.19 |
| D | ISSUED FOR DETAILED DESIGN | RS | IG | JHH | 14.12.18 |
| C | PRELIMINARY DESIGN - UPDATED | CGK | JHH | JHH | 28.09.17 |
| No. | Revision | By | Chk | Appd | Date |

Drawing Originator: **Beca**

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|---------------------|-----------------|--------|----------|----------------------------|
| Original Scale (A1) | Design | RS/JHH | 22.03.19 | Approved For Construction* |
| 1: 1000 | Drawn | GP | 22.03.19 | |
| Reduced Scale (A3) | Design Verifier | KS/IG | 22.03.19 | |
| 1: 2000 | Design Check | SS | 09.03.20 | Date |

* Refer to Revision 1 for Original Signature

Client: **PORT OTAGO LTD**

Project: **TE RAUONE BEACH MANAGEMENT SCHEME**

Title: **GENERAL ARRANGEMENT PLAN**

DETAILED DESIGN NOT FOR CONSTRUCTION

Discipline: **CIVIL ENGINEERING**

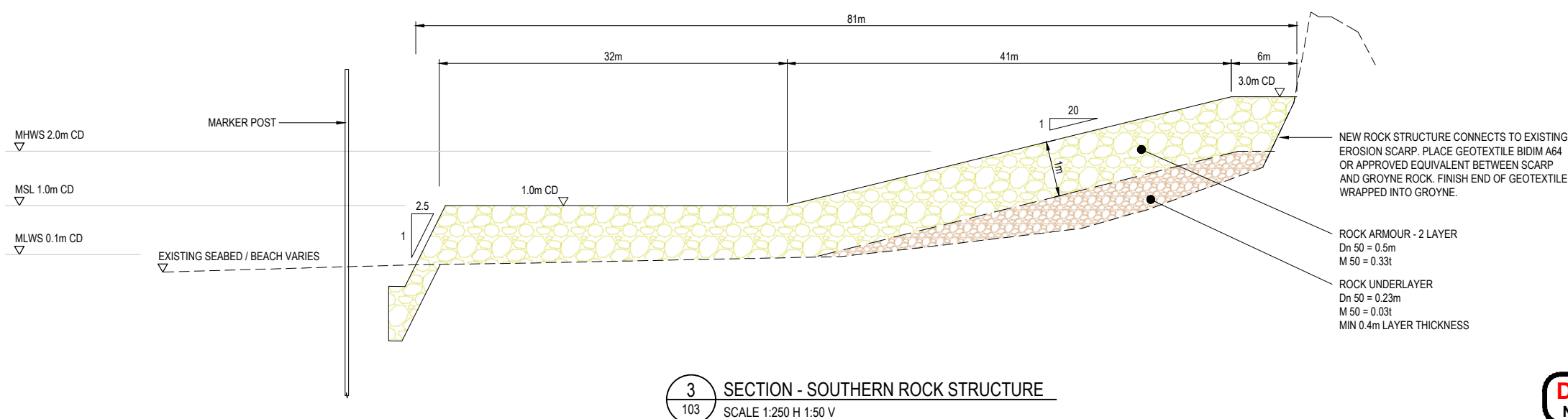
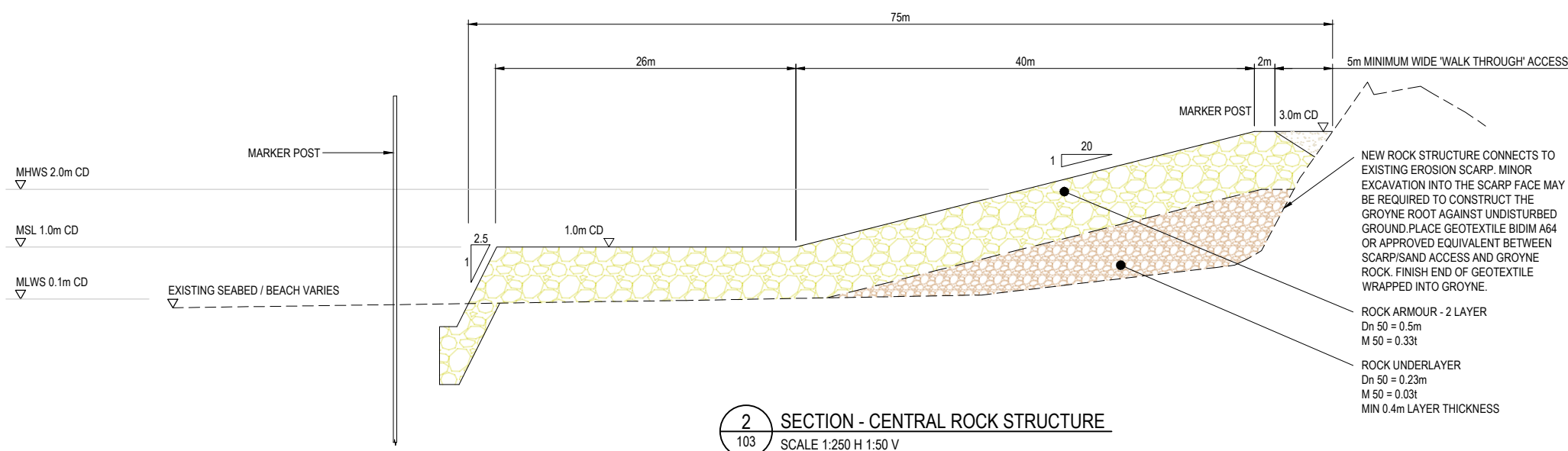
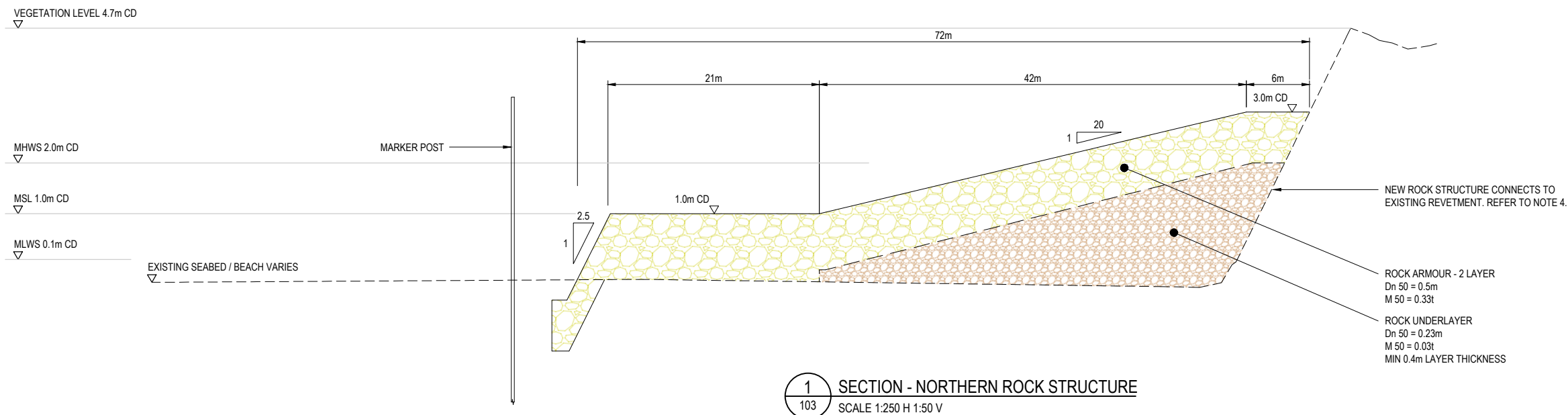
Drawing No: **3331121-CA-103**

Rev: **G**



NOTES:

- SECTIONS BASED ON JULY 2017 PPG SURVEY.
- MARKER POSTS TO BE AS PER STANDARD PORT OTAGO CHANNEL MARKERS.
- BATHYMETRIC AND TOPOGRAPHIC SURVEY TO BE UNDERTAKEN AND USED TO CONFIRM/UPDATE DESIGN PRIOR TO PROCUREMENT AND CONSTRUCTION.
- CONNECTION BETWEEN NEW ROCK STRUCTURE AND EXISTING REVETMENT AS DIRECTED BY THE ENGINEER ON SITE. CONNECTION INCLUDES RECONSTRUCTION OF EXISTING REVETMENT APPROXIMATELY 5m EITHER SIDE OF NORTHERN ROCK STRUCTURE. CONNECTION WORKS MAY INCLUDE:
 - REMOVAL OF EXISTING LARGE ROCK FROM MID AND UPPER REVETMENT FOR PRE-USE.
 - RE-SHAPING OF REVETMENT FACE TO 1:2 SLOPE WITH ADDITION OF NEW CORE ROCK, ALLOWING FOR ARMOUR TRANSITION INTO EXISTING REVETMENT AT NORTH AND SOUTH SIDES.
 - PLACEMENT OF CORE ROCK AGAINST RESHAPED REVETMENT FACE TO FORM LANDWARD END OF NEW ROCK STRUCTURE.
 - PLACEMENT OF NEW ARMOUR AND RE-USED LARGE ROCK ON NEW ROCK STRUCTURE AND RESHAPED REVETMENT TO GIVE INTERLOCKED FINISH WITH 1:2 SLOPE, TRANSITIONING INTO EXISTING REVETMENT AT NORTH AND SOUTH SIDES.



| No. | Revision | By | Chk | Appd | Date |
|-----|----------------------------|------|-----|------|----------|
| F | UPDATED CONSENTING ISSUE | CVDM | JHH | JHH | 06.03.20 |
| E | REISSUED DETAILED DESIGN | MA | JHH | JHH | 19.04.19 |
| D | REISSUED DETAILED DESIGN | GP | JHH | JHH | 22.03.19 |
| C | ISSUED FOR DETAILED DESIGN | RS | IG | JHH | 14.12.18 |
| B | PRELIMINARY DESIGN | CGK | JHH | RC | 23.08.17 |



| Original Scale (A1) | Design | RS/JHH | 22.03.19 | Approved For Construction* |
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| AS SHOWN | Drawn | CGK/GP | 22.03.19 | |
| Reduced Scale (A3) | Design Checker | KS/IG | 22.03.19 | |
| HALF SCALE | Design Checker | SS | 09.03.20 | Date |

* Refer to Revision 1 for Original Signature

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| Client: | PORT OTAGO LTD |
| Project: | TE RAUONE BEACH MANAGEMENT SCHEME |

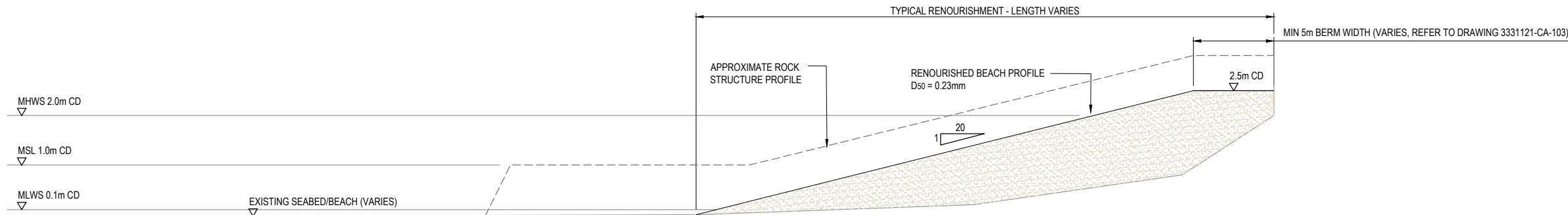
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| Title: | ROCK STRUCTURES LONGITUDINAL SECTIONS |
|--------|---------------------------------------|

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|-------------|-------------------|
| Discipline: | CIVIL ENGINEERING |
| Drawing No: | 3331121-CA-104 |
| Rev: | F |

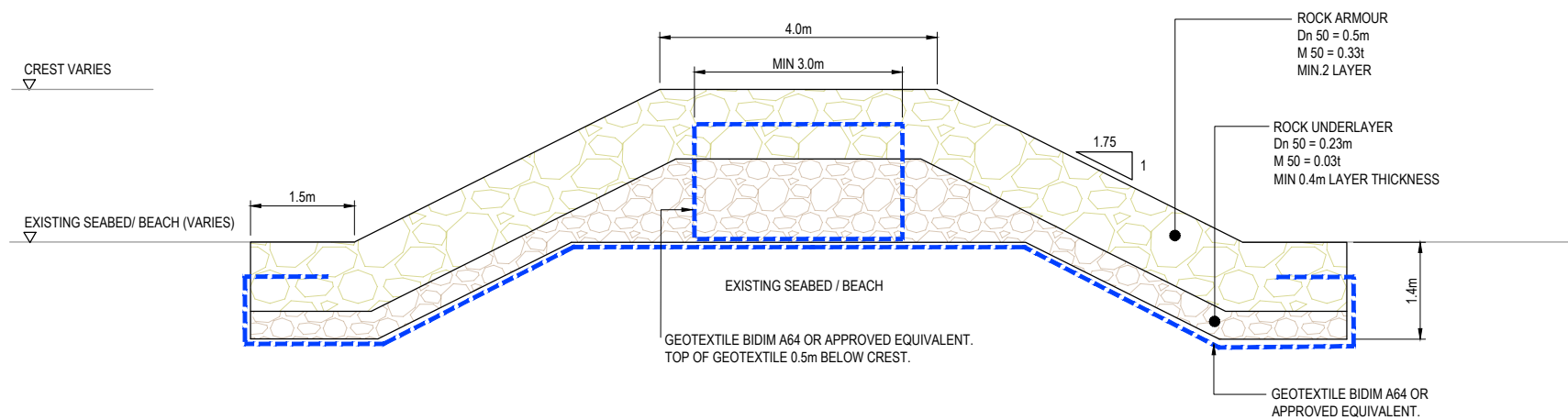
DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

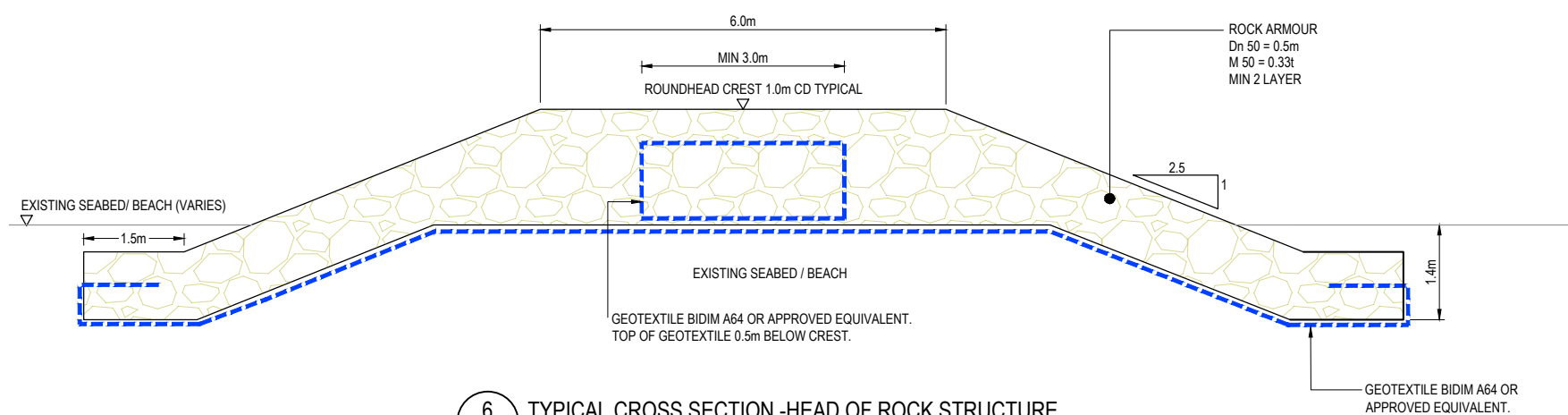
1. SECTIONS BASED ON JULY 2017 PPG SURVEY.
2. GRADE LANDWARD EDGE OF BEACH BERM BETWEEN RENOURISHED BEACH AND IN SITU GROUND.
3. BATHYMETRIC AND TOPOGRAPHIC SURVEY TO BE UNDERTAKEN AND USED TO CONFIRM/UPDATE DESIGN PRIOR TO PROCUREMENT AND CONSTRUCTION.



4 TYPICAL CROSS SECTION - BEACH RENOURISHMENT
103 SCALE 1:250 H 1:50 V



5 TYPICAL CROSS SECTION - LANDWARD SECTION OF ROCK STRUCTURE
103 SCALE 1:50



6 TYPICAL CROSS SECTION - HEAD OF ROCK STRUCTURE
103 SCALE 1:50

| | | | | | |
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| F | UPDATED CONSENTING ISSUE | CVDM | JHH | JHH | 06.03.20 |
| E | REISSUED FOR DETAILED DESIGN | MA | JHH | JHH | 19.04.19 |
| D | REISSUED FOR DETAILED DESIGN | GP | JHH | JHH | 22.03.19 |
| C | ISSUED FOR DETAILED DESIGN | RS | IG | JHH | 14.12.18 |
| B | PRELIMINARY DESIGN | CGK | JHH | RC | 23.08.17 |
| No. | Revision | By | Chk | Appd | Date |



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| Original Scale (A1) AS SHOWN | Design | RS/JHH | 22.03.19 | Approved For Construction* |
| Reduced Scale (A3) | Drawn | CGK/GP | 22.03.19 | |
| | Design Checker | KS/IG | 22.03.19 | |
| | Design Verifier | SS | 09.03.20 | Date |

HALF SCALE *Refer to Revision 1 for Original Signature

Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: ROCK STRUCTURES TYPICAL CROSS SECTION

DETAILED DESIGN NOT FOR CONSTRUCTION

| | |
|-------------|-------------------|
| Discipline | CIVIL ENGINEERING |
| Drawing No. | 3331121-CA-105 |
| Rev. | F |

ARMOUR ROCK SPECIFICATION:

THIS SPECIFICATION SHALL BE READ IN CONJUNCTION WITH THE STANDARD 'CIRIA C683 THE ROCK MANUAL - THE USE OF HYDRAULIC ROCK IN ENGINEERING, 2007' AND ALL MATERIALS AND WORKMANSHIP SHALL COMPLY WITH THIS STANDARD UNLESS EXPRESSLY NOTED OTHERWISE. THE CONTRACTOR SHALL PREPARE A METHOD STATEMENT FOR THE ENGINEER'S REVIEW INCLUDING SOURCES OF MATERIAL AND QUARRYING, HOW THE SPECIFIED GRADINGS WILL BE ACHIEVED, TRANSPORT AND STOCKPILING, ROCK PLACEMENT, SURVEY TECHNIQUES, HEALTH AND SAFETY AND ENVIRONMENTAL MATTERS.

THE CONTRACTOR SHALL NOMINATE AT THE TIME OF TENDER, THE SOURCE AND MATERIAL TYPE FOR THE ROCK. SOURCE TESTING AND GRADING IS REQUIRED FOR EACH OF THE TESTS DESCRIBED BELOW UNDER ROCK QUALITY AND ROCK GRADING AND RESULTS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW PRIOR TO THE COMMENCEMENT OF WORKS. TESTING IS TO BE UNDERTAKEN AT AN IANZ ACCREDITED LABORATORY.

THE CONTRACTOR SHALL CARRY OUT PRE AND POST WORK SURVEYS AND MEASUREMENT SURVEYS TO SUPPORT PROGRESS PAYMENT APPLICATIONS. SURVEY OF ROCK BE CARRIED OUT USING A PROBE WITH A SPHERICAL END OF DIAMETER 0.5Dn50, WHERE Dn50 IS THE SIZE OF THE CUBE WITH EQUIVALENT VOLUME TO THE BLOCK WITH MEDIAN WEIGHT.

ROCK QUALITY

EACH TEST SPECIFIED BELOW SHALL COMPRISE A MINIMUM OF THREE SAMPLES.

- ARMOUR STONE SHALL BE HARD, DURABLE, CRUSHED, QUARRIED OR NATURAL STONE FREE FROM DUST, CLAY, ORGANIC MATTER AND OTHER DELETERIOUS MATERIAL. THE STONE SHALL BE FREE FROM LAMINATIONS AND CLEAVAGES AND SHALL NOT DISINTEGRATE ON EXPOSURE TO WEATHERING.
- THE SOLID DENSITY (SSD) OF ARMOUR STONE SHALL BE AT LEAST 2.5 t/m³ IN ACCORDANCE WITH NZS 4407:1991.
- THE ARMOUR STONE SHALL HAVE A WATER ABSORPTION LESS THAN 2.0% IN ACCORDANCE WITH NZS 3111:1986.
- RESISTANCE TO ABRASION - LOS ANGELES ABRASION NOT MORE THAN 20% LOSS IN WEIGHT IN ACCORDANCE WITH NZS 4407:1991.

RESISTANCE TO WEATHERING

- THE QUARRY STONE USED FOR ARMOUR AND UNDERLAYER SHALL HAVE A QUALITY INDEX OF AA, AB, BA WHEN TESTED IN ACCORDANCE WITH NZS 4407:1991 TEST 3.11

ROCK GRADING AND SHAPE

- THE ARMOUR AND UNDERLAYER ROCK GRADING IS AS FOLLOWS:

| ROCK GRADING | | | | | | |
|-------------------------|--------------------------|-----------------|---------------------|-----------------------|-----------------------|------------------------------------|
| NOMINAL M ₅₀ | NOMINAL D _{n50} | LAYER THICKNESS | MAX | <15% PASSING | MIN | D _{n65} /D _{n15} |
| (kg) | (m) | (m) | (kg) | (kg) | (kg) | |
| 330 | 0.50 | REFER DRAWINGS | 2 x M ₅₀ | 0.5 x M ₅₀ | 0.3 x M ₅₀ | <2 |
| 30 | 0.23 | REFER DRAWINGS | 2 x M ₅₀ | 0.5 x M ₅₀ | 0.3 x M ₅₀ | <2 |

ROCK SHAPE : ARMOUR AND STONE SHALL HAVE A LENGTH (L) TO WIDTH (W) RATIO OF LESS THAN 3. 50% OF STONES SHALL NOT HAVE A LW RATIO GREATER THAN 2.

TEST FREQUENCY

- ROCK PROPERTIES AND GRADING TO BE UNDERTAKEN AND SUBMITTED TO THE ENGINEER FOR REVIEW PRIOR TO WORK COMMENCING.
- ROCK PROPERTIES AND GRADING TO BE REPEATED IF MATERIAL SOURCE CHANGES AND AT 2000h INTERVALS.

CONSTRUCTION

- PLACING OF EACH LAYER SHALL COMMENCE AT THE TOE AND SHALL PROCEED UPWARDS TOWARDS THE TOP.
- ROCKS SHALL BE PLACED TO:
 - ACHIEVE A WELL KEYED, DENSELY PACKED STRUCTURE WITH A TARGET BULK DENSITY OF 1.6 t/m³ WITH A TOLERANCE OF ±0.1 t/m³.
 - ACHIEVE EFFECTIVE INTERLOCKING, SO THAT EACH ROCK IS SECURELY HELD IN PLACE BY ITS NEIGHBOURS AND DOES NOT DEPEND ON FRICTIONAL RESISTANCE FOR STABILITY PRIOR TO PLACING FURTHER STONES.
 - ACHIEVE A FINISHED LAYER AT LEAST TWO ROCKS THICK UNLESS SHOWN OTHERWISE ON THE DRAWINGS.
 - AVOID FORMING, WITHIN THE OVERALL THICKNESS OF THE LAYER, SEPARATE LAYERS IN THE PLANE PARALLEL TO THE SLOPE OF THE UNDERLYING MATERIAL.
- UNDERLAYER AND ARMOUR ROCK SHALL BE PLACED AS SOON AS PRACTICABLE TO PROTECT THE UNDERLYING MATERIAL. MATERIAL ERODED BY WAVE ACTION OR ANY OTHER CAUSE SHALL BE MADE GOOD BY THE CONTRACTOR, AT THE CONTRACTOR'S OWN EXPENSE BEFORE PLACING THE APPROPRIATE PROTECTIVE LAYER.

TOLERANCES

- HORIZONTAL TOLERANCE FOR ROCK RIPRAP, UNDERLAYER AND ARMOUR TO BE ±0.25m
- VERTICAL TOLERANCE FOR UNDERLAYER TO BE ±0.1m AND FOR RIPRAP AND ROCK ARMOUR ±0.2m,

GEOTEXTILE

- GEOTEXTILE SHALL COMPLY WITH AS 3706, GEOTEXTILES.
- GEOTEXTILE (BIDIM A64) SHALL BE KEPT IN ITS PROTECTIVE WRAPPING ON THE SITE AND STORED OUT OF DIRECT SUNLIGHT SO IT IS NOT EXPOSED TO ULTRA-VIOLET LIGHT PRIOR TO INSTALLATION. GEOTEXTILE THAT IS NOT IMMEDIATELY COVERED AFTER INSTALLATION SHALL BE COVERED WITH AN APPROVED MATERIAL OF SUFFICIENT THICKNESS TO PROTECT IT FROM ULTRA-VIOLET LIGHT. GEOTEXTILE THAT IS DAMAGED SHALL BE REJECTED AND REMOVED FROM SITE.
- THE MINIMUM LAP WIDTH OF ADJACENT STRIPS OF GEOTEXTILE SHALL BE 1000mm.

SAND RE-NOURISHMENT SPECIFICATION:

THIS SPECIFICATION REFERS TO THE PLACEMENT AND SPREADING OF SAND RE-NOURISHMENT MATERIAL TO ESTABLISH BEACHES BETWEEN THE ROCK GROYNES AT TE RAUONE. SAND IS TO BE DEPOSITED AND SPREAD ON THE BEACH AS AGREED WITH THE ENGINEER TO ACHIEVE THE DESIGN BEACH PROFILES SHOWN ON THE DRAWINGS. ACCESS TO THE BEACH AND PLACEMENT OF SAND WILL BE LIMITED BY TIDAL AND WEATHER CONDITIONS, AND THE CONTRACTOR IS REQUIRED TO MANAGE THE SAND PLACEMENT PROCESS TO ENSURE THAT THE VOLUME TO BE DEPOSITED BETWEEN TIDES IS PLACED AND SPREAD TO THE MAXIMUM SPECIFIED LIFT THICKNESS BEFORE IT IS EXPOSED TO THE TIDE. THIS PROCESS IS REQUIRED TO MINIMISE LOSS OF MATERIAL OFFSHORE AS THE BEACH IS ESTABLISHED.

THE CONTRACTOR WILL BE EXPECTED TO OBSERVE THE NATURAL SAND DISTRIBUTION PROCESS AFTER PLACEMENT AND ADJUST THE PLACEMENT AND SPREADING AS THE BEACH DEVELOPS TO BEST ACHIEVE THE DESIGN PROFILE MINIMIZE SAND LOSS.

RE-NOURISHMENT MATERIAL

- SAND SUPPLY

SAND AVAILABLE FOR THE RENOURISHMENT WORKS IS DREDGED MATERIAL RECOVERED FROM THE SHIPPING CHANNEL. THE GRAIN SIZE HAS BEEN ESTABLISHED AS D₅₀= 0.23 MM +0.70 MM, -0.01 MM, CLASSIFIED AS FINE SAND.
- SAND TESTING

THE CONTRACTOR SHALL OBTAIN A REPRESENTATIVE SAMPLE FROM EACH 500 CU M OF MATERIAL CARTED TO SITE, AND ARRANGE FOR TESTING TO PROVIDE A GRADING CURVE FOR EACH SAMPLE. GRADING CURVES PLOTTED TO RECOGNISED FORMAT AND CLEARLY MARKED WITH DATE AND SECTION OF BEACH TO WHICH IT WAS SUPPLIED SHALL BE SUBMITTED TO THE ENGINEER WITHIN 5 DAYS OF SAMPLING.

CONSTRUCTION

- PRIOR TO COMMENCEMENT OF SAND PLACEMENT THE CONTRACTOR SHALL CARRY OUT THE CLEARING AND REMOVAL OF ALL DEAD VEGETATION AND DEBRIS FROM THE BEACH AND DISPOSAL OFF SITE. THIS MATERIAL GENERALLY COMPRISES STRANDED TREE-STUMPS AND LOGS, AND SALTWATER AFFECTED FORESHORE VEGETATION. ANY DEAD VEGETATION REMAINING IN THE DUNE OR DUNE-FACE AND OF WHICH REMOVAL MAY AFFECT THE DUNE FACE POSITION OR STABILITY WILL BE REFERRED TO THE ENGINEER FOR DECISION ON REMOVAL OR CUTTING ON SITE. VEGETATION AND OBJECTS LANDWARD OF THE DUNE SCARP THAT ARE DESIGNATED TO REMAIN SHALL BE PRESERVED FREE FROM INJURY OR DAMAGE.
- THE PROCESS OF BEACH CONSTRUCTION SHALL COMPRISE DELIVERY OF SAND TO THE BEACH AND SPREADING IT ALONG THE BEACH TO PROVIDE MAXIMUM LIFT BETWEEN TIDAL EXPOSURES OF 0.2 M. THIS LIFT SHALL, WHERE POSSIBLE, EXTEND THE FULL LENGTH OF THE BEACH BETWEEN RESPECTIVE GROYNES, AND FILLING SHALL COMMENCE AT THE TOP OF THE BEACH ADJACENT TO THE CURRENT SCARP. THIS LIMIT TO LIFT HEIGHT IS INTENDED TO REDUCE THE EXPOSURE TO LOSS OF SAND FROM THE BEACH SYSTEM AS IT ESTABLISHES ITS NATURAL ANGLE OF REPOSE UNDER TIDAL INUNDATION AND WAVE EXPOSURE. SPREADING IS TO BE ACHIEVED BY A BULLDOZER OR SIMILAR BLADED MACHINE.
- THE CONTRACTOR IS EXPECTED TO OBSERVE THE PROCESS OF SAND DISTRIBUTION AS RENOURISHMENT PROCEEDS AND ADJUST THE POSITION OF SAND DEPOSIT TO ACHIEVE THE NOMINATED DESIGN BEACH PROFILE.
- THE REQUIRED SEQUENCE OF BEACH CONSTRUCTION IS TO CONSTRUCT THE NORTHERN SECTION OF BEACH BETWEEN THE CENTRAL AND NORTHERN GROYNES FIRST, FOLLOWED BY THE SOUTHERN SECTION, AND THE SMALL FILLET BEACH INFILL SOUTH OF THE SOUTHERN GROYNE. THIS WORK SHALL NOT BE COMMENCED UNTIL THE NORTHERN AND CENTRAL GROYNES ARE COMPLETED TO THE SATISFACTION OF THE ENGINEER WHO WILL PROVIDE WRITTEN ADVICE THAT THE RENOURISHMENT PROCESS MAY PROCEED.

PROGRESS MONITORING

- THE CONTRACTOR SHALL MAINTAIN A RUNNING RECORD OF THE MATERIAL VOLUMES PLACED INTO THE BEACH. THIS RECORD MUST BE CONSTANTLY UPDATED AND AVAILABLE TO THE ENGINEER TO MONITOR PROGRESS AGAINST SCHEDULED QUANTITIES.
- THE CONTRACTOR SHALL UNDERTAKE SURVEY OF BEACH PROFILES OF THE SECTION OF BEACH BEING FILLED FOLLOWING THE PLACEMENT OF EACH 1000 CU M OF SAND. BEACH SURFACE POSITIONS SHALL BE RECORDED FOR PROFILES AT A MAXIMUM OF 40 M CENTRES ALONG THE BEACH, AND AT 5 M CENTRES ALONG THE PROFILE BETWEEN THE INSHORE SCARP CREST AND THE 0.0 M CD BEACH LEVEL. POSITIONS SHALL BE RECORDED AS 3-DIMENSIONAL CO-ORDINATES AND SUBMITTED WITHIN 3 DAYS (OR AS OTHERWISE AGREED WITH THE ENGINEER) TO THE ENGINEER.

| No. | Revision | By | Chk. | Appd. | Date |
|-----|------------------------------|----|------|-------|----------|
| D | UPDATED FOR CONSENTING ISSUE | MA | JHH | JHH | 12.03.20 |
| C | REISSUED FOR DETAILED DESIGN | MA | JHH | JHH | 19.04.19 |
| B | REISSUED FOR DETAILED DESIGN | GP | JHH | JHH | 23.03.19 |
| A | ISSUED FOR DETAILED DESIGN | RS | IG | JHH | 20.12.18 |

Drawing Originator:



| Original Scale (A1) | Design | RS/JHH | 22.03.19 | Approved For Construction* |
|---------------------|--------------|--------|----------|----------------------------|
| NTS | Drawn | GP | 22.03.19 | |
| Reduced Scale (A3) | Dwg Verifier | KS/IG | 22.03.19 | |
| | Dwg Check | SS | 09.03.20 | Date |

* Refer to Revision 1 for Original Signature

| | |
|---------|----------------|
| Client: | PORT OTAGO LTD |
|---------|----------------|

| | |
|----------|-----------------------------------|
| Project: | TE RAUONE BEACH MANAGEMENT SCHEME |
|----------|-----------------------------------|

| | |
|--------|--|
| Title: | ROCK ARMOUR AND BEACH RENOURISHMENT SPECIFICATIONS |
|--------|--|

**DETAILED DESIGN
NOT FOR CONSTRUCTION**








| | |
|-------------|-------------------|
| Discipline | CIVIL ENGINEERING |
| Drawing No. | 3331121-CA-106 |
| Rev. | D |

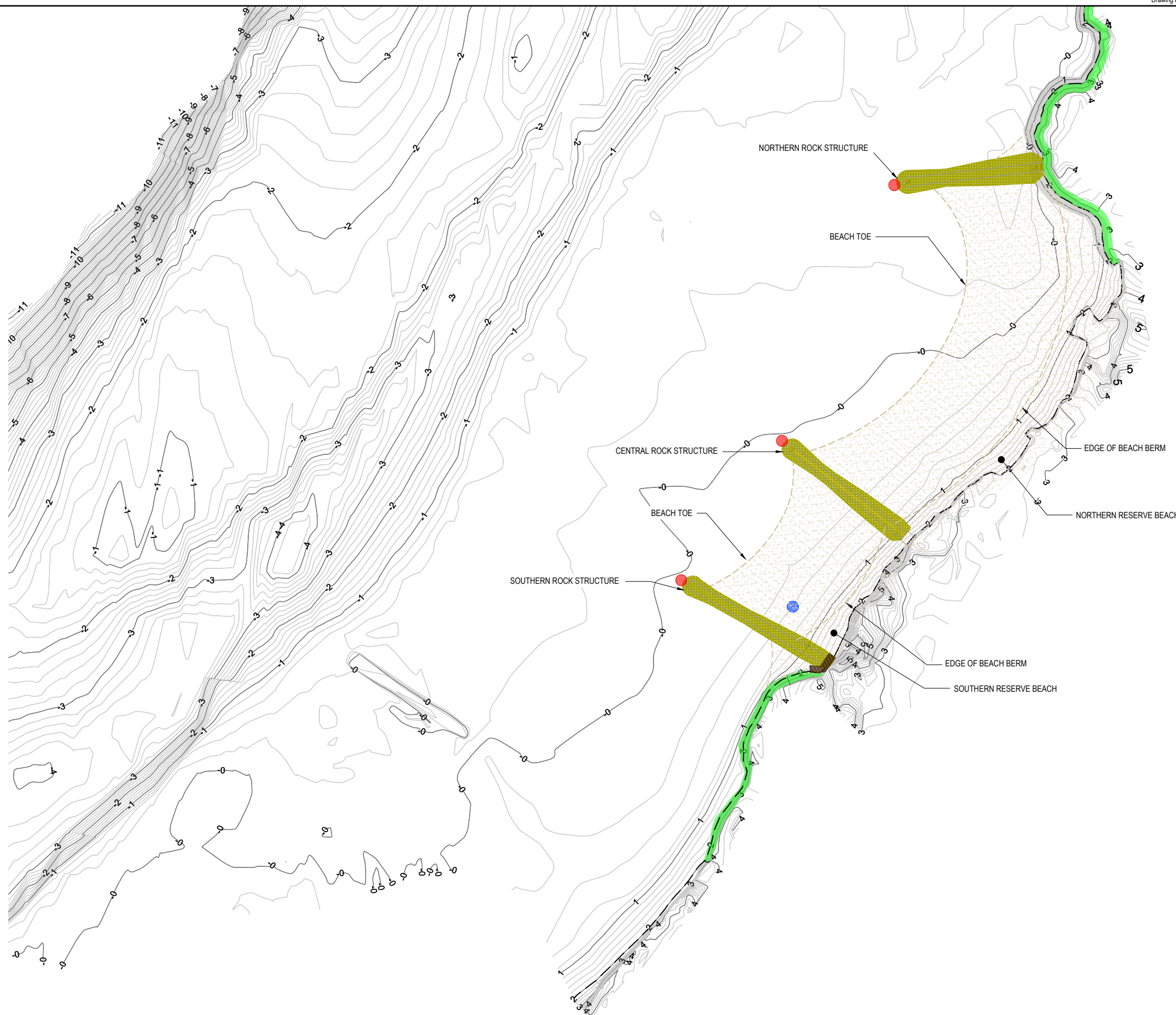


NOTES:

1. LEVELS BASED ON JULY 2017 PPG SURVEY - TO CHART DATUM. CO ORDINATES TO NZTM 2000.
2. HISTORIC GROYNE POSITIONS PROVIDED BY HERITAGE NEW ZEALAND POUHERE TAONGA.

LEGEND:

-  PROPOSED BEACH RENOURISHMENT
-  PROPOSED ROCK STRUCTURE
-  PROPOSED MARKER
-  SETOUT POINT
-  EXISTING ROCK REVETMENT
-  HISTORIC GROYNE POSITION
-  EXISTING MEAN HIGH WATER SPRINGS



| No. | Revision | By | Chk | Appd | Date |
|-----|--------------------------|-----|-----|------|----------|
| C | UPDATED CONSENTING ISSUE | SPS | JHH | JHH | 09.03.20 |
| B | FOR CLIENT REVIEW | SPS | JHH | JHH | 19.11.19 |
| A | FOR CLIENT REVIEW | SPS | JHH | JHH | 13.11.19 |

Drawing Originator:



| Original Scale (A1) | Design | Drawn | 13.11.19 | Approved For Construction* |
|---------------------|--------------|-------|----------|----------------------------|
| 1: 1000 | SPS | | | |
| Reduced Scale (A3) | Design Check | SS | 09.03.20 | Date |
| 1: 2000 | | | | |

* Refer to Revision 1 for Original Signature

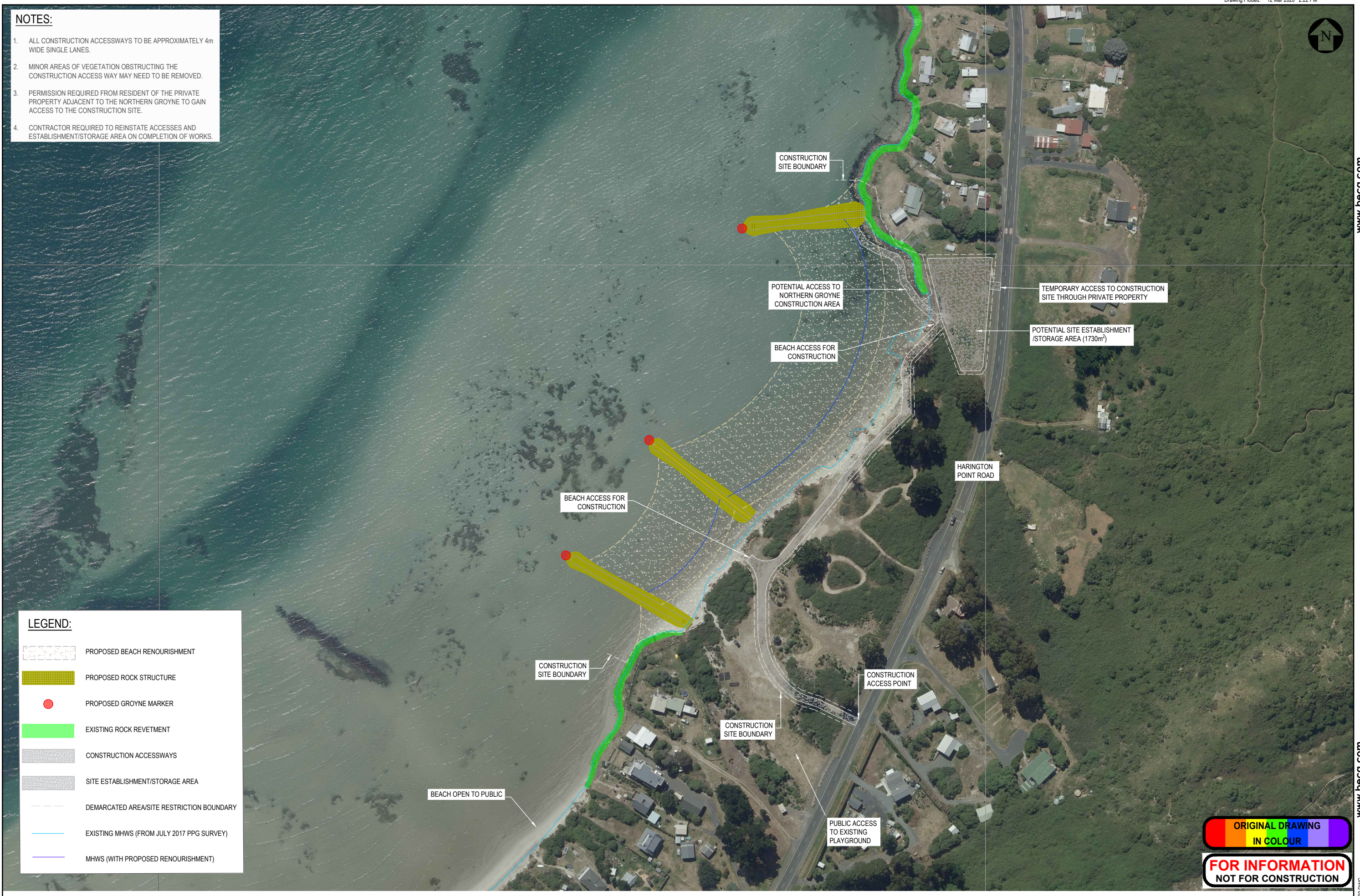
Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: HISTORIC GROYNE LOCATION PLAN

| | |
|---|-------------------|
| FOR CLIENT REVIEW NOT FOR CONSTRUCTION | |
| Discipline | CIVIL ENGINEERING |
| Drawing No. | 3331121-CA-115 |
| Rev. | C |

- NOTES:**
1. ALL CONSTRUCTION ACCESSWAYS TO BE APPROXIMATELY 4m WIDE SINGLE LANES.
 2. MINOR AREAS OF VEGETATION OBSTRUCTING THE CONSTRUCTION ACCESS WAY MAY NEED TO BE REMOVED.
 3. PERMISSION REQUIRED FROM RESIDENT OF THE PRIVATE PROPERTY ADJACENT TO THE NORTHERN GROYNE TO GAIN ACCESS TO THE CONSTRUCTION SITE.
 4. CONTRACTOR REQUIRED TO REINSTATE ACCESSES AND ESTABLISHMENT/STORAGE AREA ON COMPLETION OF WORKS.



ORIGINAL DRAWING
IN COLOUR
**FOR INFORMATION
NOT FOR CONSTRUCTION**

| No. | Revision | By | Chk | Appd | Date |
|-----|--------------------------|------|-----|------|----------|
| B | UPDATED CONSENTING ISSUE | CVDM | JH | JH | 09.03.20 |
| A | FOR INFORMATION ONLY | CVDM | JH | JH | 28.02.20 |



| | | | | | |
|---------------------|---------|--------------|----------|----------------------------|---|
| Original Scale (A1) | 1: 1000 | Design | - | Approved For Construction* | - |
| Drawn | CVDM | Drawn | 28.02.20 | Date | - |
| Reduced Scale (A3) | 1: 2000 | Dwg Verifier | - | Date | - |
| | | Dwg Check | SS | 09.03.20 | |

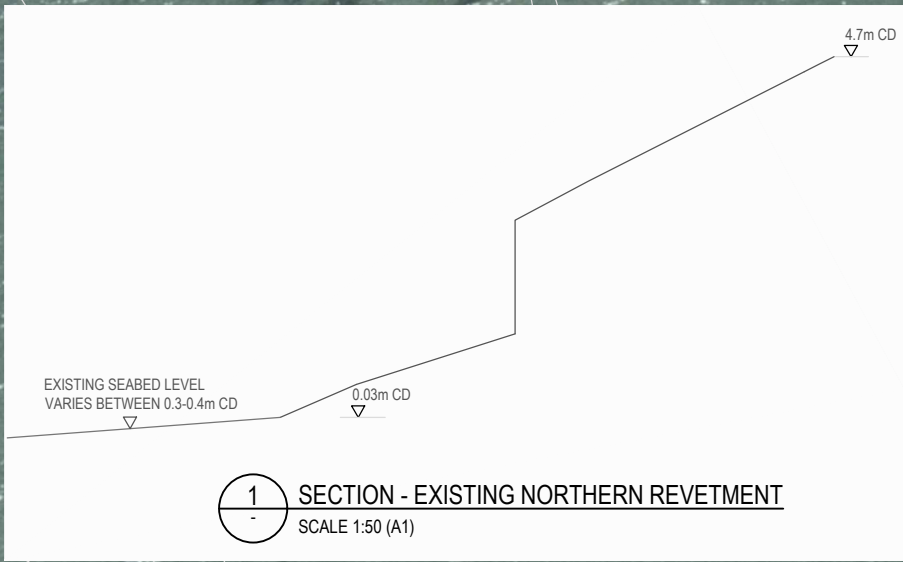
* Refer to Revision 1 for Original Signature

Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: TEMPORARY CONSTRUCTION AREAS AND ACCESS

Discipline: CIVIL ENGINEERING
Drawing No: 3331121-SK-002
Rev: B



EXISTING NORTHERN REVETMENT

EXTENT OF SEAWALL



NOTES:
 1. LEVELS BASED ON JULY 2017 PPG SURVEY - TO CHART DATUM. CO ORDINATES TO NZTM 2000.

LEGEND:
 — PROPERTY BOUNDARY
 — EXISTING MHWS (FROM JULY 2017 PPG SURVEY)

ORIGINAL DRAWING
 IN COLOUR
**FOR INFORMATION
 NOT FOR CONSTRUCTION**

| No. | Revision | By | Chk. | Appd. | Date |
|-----|----------------------|------|------|-------|----------|
| A | FOR INFORMATION ONLY | CVDM | JH | JH | 09.03.20 |



| | | | |
|------------------------------|-----------------|----------|----------------------------|
| Original Scale (A1) 1:250 | Design CVDM | 21.02.20 | Approved For Construction* |
| Reduced Scale (A3) 1:500 | Drawn | | |
| | Design Verifier | SS | Date |
| | Design Check | SS | 09.03.20 |

* Refer to Revision 1 for Original Signature

Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: EXISTING REVETMENT PLAN

Discipline: CIVIL ENGINEERING
 Drawing No: 3331121-SK-003
 Rev: A

Australia

Fiji

Indonesia

Myanmar

New Caledonia

New Zealand

Singapore

Thailand

Appendix C – Traffic Assessment

19 November 2019

Lezel Botha
Senior Environmental Planner
GHD
via e-mail: Lezel.Botha@ghd.com

Our ref: /12503757/00

Dear Lezel

12503757 - Te Rauone Beach Scoping and Consenting Traffic Assessment

1 Introduction

Te Rauone Beach has a history of sand loss and realignment over the past century, with the northern end retreating landwards while the southern end has built seaward. The erosion along the unprotected north end face of the Te Rauone Reserve is the most dramatic, while protective works by property owners to the north of the reserve have had various degrees of success.

1.1 Description of proposed activity

The site is located in Te Rauone Beach Reserve, coordinates: -45.793352, 170.693293. The location is illustrated in Figure 1 below.



Figure 1 - Site Location

The proposal is to construct groynes and undertake sand replenishment to mitigate the erosion issues. Three rock groynes are to be constructed in front of the Te Rauone Beach Reserve area and sand to be

deposited along the north end of Te Rauone Beach Reserve. The deposition area relates to approximately 280 metres of coastline and varies in width.

This activity involves transporting approximately 1,200 m³ of sand and 4,200 m³ of rock with minimal stockpiling on site. The sand will be transported from T&U Wharf in Fryatt Street Dunedin, and the rock will likely be transported from Logan Point Quarries, situated at 1 Ravensbourne Road, Dunedin. A site locality plan is illustrated in Figure 2 below.



Figure 2 - Site Locality Plan

It is anticipated that the works associated with trucking materials to site will take approximately 8 weeks to complete, but could extend longer depending on weather and other external factors.

The solution has been developed over a 10+ year period with significant community input as well as professional coastal engineering design advice provided by Beca, Dr Martin Single and Port Otago Ltd.

1.2 Adjacent land use

Te Rauone Beach Reserve is classified Recreation, and the adjacent land use is classified residential - Township and Settlement. District plan map of the area is illustrated in Figure 3 below.

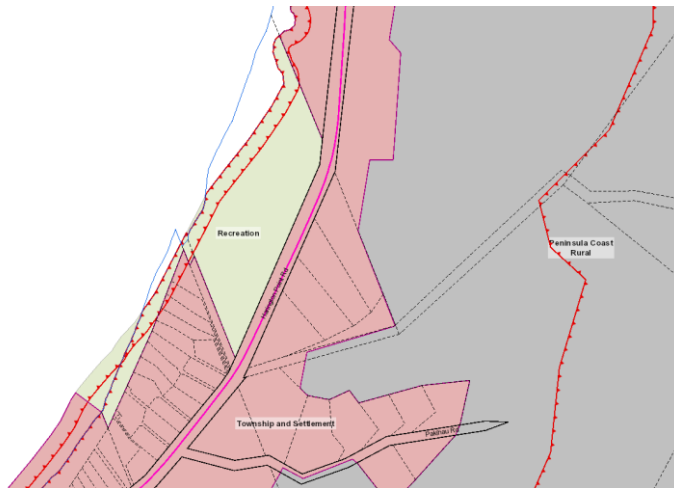


Figure 3 - District Plan Map

1.3 The purpose

This desktop traffic assessment investigates the traffic effects relating to the transportation of 1200 m³ of sand and 4,200m³ of rock with minimal stockpiling on site. It is prepared to support the resource consent application. The extent of the works involve construction of groynes and undertaking of sand replenishment to mitigate the erosion issues at Te Rauone Beach.

1.4 Assumptions

- The desktop assessment of the haulage route to be undertaken from Portobello Road to the Te Rauone Beach assumes there is sufficient capacity in the upstream local network.
- Accident search using NZTA Crash Analysis System was undertaken along Harington Point Road adjacent to Te Rauone Beach Reserve.
- We have not validated the data obtained from MobileRoads with a site visit. This is a desktop assessment only.

1.5 Scope and limitations

This letter has been prepared by GHD for Port Otago and may only be used and relied on by Port Otago for the purpose agreed between GHD and the Port Otago as set out in section 1.3 of this letter.

GHD otherwise disclaims responsibility to any person other than Port Otago arising in connection with this letter. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this letter were limited to those specifically detailed in the letter and are subject to the scope limitations set out in the letter.

The opinions, conclusions and any recommendations in this letter are based on conditions encountered and information reviewed at the date of preparation of the letter. GHD has no responsibility or obligation to update this letter to account for events or changes occurring subsequent to the date that the letter was prepared.

The opinions, conclusions and any recommendations in this letter are based on assumptions made by GHD described in this letter (refer section(s) 5 of this letter). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this letter on the basis of information provided by Port Otago and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the letter which were caused by errors or omissions in that information.

2 Existing transport data

Transport data has been extracted from Mobile Road, which is a free collaborative app hosted at Auckland Motorways. Data was extracted at intervals along the route between Portobello Road from the intersection of Shore Street (illustrated as route start in Figure 2 - Site Locality Plan above) and Te Rauone Beach Reserve. The extracted data includes traffic flows (ADT), road widths and ONRC, please refer to Table 1 below.

Table 1 Transport Data NZTA Mobileroad

| Position | Road / MobileRoads Route Position (start of road towards site in km) | Traffic Flows (ADT) | Carriageway Width | ONRC |
|----------|--|---------------------------------------|----------------------|-------------------|
| 1 | PORTOBELLO RD (EAST-EAST/R)/0.078 | 13400 (est) 28/01/2019 1.81% heavy | 7.5m | Arterial |
| 2 | PORTOBELLO RD (EAST-EAST/R)/1.212 | 5400 (est) 28/01/2019 1.81% heavy | 7m | Arterial |
| 3 | PORTOBELLO RD (EAST-EAST/R)/1.746 | 5400 (est) 28/01/2019 2.91% heavy | 6.9m | Arterial |
| 4 | PORTOBELLO RD (EAST-EAST/R)/3.166 | 5400 (est) 28/01/2019 2.12% heavy | 5.9m | Arterial |
| 5 | PORTOBELLO RD (EAST-EAST/R)/8.444 | 3100 (est) 28/01/2019 2.12% heavy | 8.4m | Arterial |
| 6 | PORTOBELLO RD (EAST-EAST/R)/11.916 | 2100 (est) 28/01/2019 2.12% heavy | 6.2m | Arterial |
| 7 | PORTOBELLO RD (EAST-EAST/R)/15.713 | 1350 (est) 28/01/2019 1.81% heavy | 6.5m | Arterial |
| 8 | HARINGTON POINT RD (EAST/R)/0.201 | 1500 (est) 28/01/2019 1.55% heavy | 5.5m | Primary Collector |
| 9 | HARINGTON POINT RD (EAST/R)/1.437 | 1350 (est) 28/01/2019 2.91% heavy | 9.6m | Primary Collector |
| 10 | HARINGTON POINT RD (EAST/R)/2.613 | 1300 (est) 28/01/2019 2.91% heavy | 9.3m | Primary Collector |
| 11 | HARINGTON POINT RD (EAST/R)/3.570 | 600 (est) 28/01/2019 2.94% heavy | 9m | Primary Collector |
| 12 | HARINGTON POINT RD (EAST/R)/6.199 | 600 (est) 28/01/2019 2.94% heavy | 5.9m | Primary Collector |
| 13 | HARINGTON POINT RD (EAST/R)/8.684 | 450 (est) 28/01/2019 2.94% heavy | 6.5m | Primary Collector |

Typical traffic lanes are 3.5 m, by comparison traffic lanes identified at some sections along the route are considered to be very narrow – 2.75m (5.5m carriageway width). Google Earth street view image of this narrow section is illustrated in Figure 4 below.



Figure 4 - Narrow Road section identified (HARINGTON POINT RD (EAST/R)/0.201)

The maximum allowed legal width of a standard vehicle is 2.55 m, including HPMVs (High Productivity Motor Vehicles). This maximum standard width excludes specific vehicle adornments such as:

- Collapsible wing-mirrors (up to 2.98 m width)
- Cab exterior grab rails (up to 2.65 m width)
- Cameras or proximity warning systems (no more than 70 mm from vehicle sidewall)

An accident search was undertaken using NZTA Crash Analysis System along Harington Point Road adjacent to Te Rauone Beach Reserve. The search area was selected using a 100m buffer along the road centreline, and is illustrated in Figure 5 below.



Figure 5 - Crash Analysis Area

The database was queried for a 10 year period from the start of 2009 to end of 2018. The search query returned no recorded crash results.

3 Proposal details

An aerial image of The Te Rauone Beach Reserve site is illustrated in Figure 6 below.



Figure 6 - Te Rauone Beach Reserve Site

The extent of the erosion is visible towards the northern end of the reserve (right of the image above as circled above in red). This site has road access from Harington Point Rd. Harington Point Rd is classified as a Collector Road under the Dunedin City Council Road Hierarchy plan, and a Primary Collector under the ONRC. It currently has a sign posted speed limit of 50 km/hr.

3.1 Operational hours

The hours of operation has not been provided as a suitable contractor is yet to be appointed. The preferred hours of operation are between 7.30am – 6.00pm Monday to Saturday, with no movements on a Sunday or public holidays.

3.2 Site Access and Site Operations

Site access will be along a gravel/unsealed access road as illustrated in Figure 7 below.



Figure 7 - Site Access (Source: google Earth)

There is sight distance of greater than 100m on both direction, and there are no visibility issues.

It is recommended that the contractor provides a designated truck and trailer wait area and safe turning facilities within the site.

A contractor's site establishment area will be required. While no location has yet been identified, subject to relevant permissions, the establishment area is expected to be located on the DCC reserve or an adjacent landowner's property. Site offices, plant, materials and staff parking will be located in this establishment area. Minimal stockpiling of rock is anticipated.

During the construction period, access to the beach and foreshore, site establishment area and site access ways will temporarily be restricted to the public, in order to safeguard the public and the contractor's staff. This will be achieved using temporary site fencing and signage.

Disestablishment, including reinstatement of the contractor's site area, will be completed at the end of construction.

Temporary traffic management plan will be in place to manage the traffic around the construction site.

3.3 Vehicle-trip generation

The proposal is to utilise truck and trailer units to transport rock on to site, and trucks to transport sand on to site.

Trucks

Rock volumes required for the groyne construction is currently estimated to be 4,200m³. It is assumed the truck and trailer units with a capacity of approximately 13m³ will be utilised. Based on full load movements, it will take approximately 325 trips, 650 directional movements throughout the project duration.

There may be up to 11 round trip truck and trailer movements hauling rocks per day, i.e up to three round-trip movements per hour.

Some land-based renourishment may be required initially to provide a sand base before the pumped renourishment starts. The quantity is currently estimated to be approximately 1,200 m³ and this will be transported using trucks with an assumed capacity of 6 m³. Based on full load movements, it will take approximately 200 trips, 400 directional movements.

There may be up to 8 round trip truck and trailer movements hauling sand per day, i.e up to two round-trip movements per hour.

The truck movements in and out of the site will be controlled under the temporary traffic management plan.

Table 2 Trip generation

| Haulage Material | Haulage Volume | Total round trips | Maximum round trips per day | Maximum round trips per hour |
|------------------|----------------------|-------------------|-----------------------------|------------------------------|
| Rock | 4,200 m ³ | 325 | 11 | 3 |
| Sand | 1,200 m ³ | 200 | 8 | 2 |

The sand and rock haulage activities will be undertaken separately according to discrete timelines and will be scheduled to not run concurrently. The maximum number of daily induced trips as a result of this activity is 11 round trip truck and trailer movements per day, i.e up to three round-trip movements per hour.

Other vehicles

It is assumed that each of the operators will arrive to site independently of each other. It is anticipated there will be up to 8 operators on site, i.e eight trips to site over and above the numbers listed in Table 2 above.

In addition, the occasional ute or small truck will also access the site to provide fuel or maintenance services for trucks or equipment. These vehicles are likely to be less than one per day.

4 Appraisal of transportation effects

The traffic volumes in the environment are sufficiently low that an additional 11 round-trip truck movements per day i.e. up to three round-trip truck movements per hour will have a less than minor effect on the traffic flow in the network. Assuming three trucks on rotation there should be on average a separation of 20 minutes between trucks, which will mean that the trucks should not back up at the intersections.

The assessment identified a narrow section of road with lane width of approximately 2.75m (5.5m carriageway width). There is a possibility of vehicle conflict if the combined width of two of the widest truck units in the fleet is close or greater than the available carriageway width at any section of the route. If this is the case then it is suggested that this issue is investigated further prior to material transport. Possible mitigation measure that could be developed further include:

- All truck units are in communication to avoid trucks passing on the narrow sections and manage conflicts. This could be achieved using two-way radios.
- Suitable operational control could be implemented such as priority for one approach while the other direction gives way. It is also suggested that the same pool of drivers are utilised throughout the project period that will become familiar and comfortable with the routes.

The surrounding area is residential, and to minimise noise issues, engine braking should be discouraged along the route where possible.

5 Summary

This desktop traffic assessment investigates the traffic effects relating to the transportation of 1200 m³ of sand and 4,200m³ of rock with minimal stockpiling on site. It is prepared to support the resource consent application. The rock will be sourced from Logan Point Quarries and transported to the site by truck and trailer units, and the sand will be sourced from T&U Wharf in Fryatt Street Dunedin and transported by truck units. They will use the predefined route along Portobello Road / Harington Point Road.

The additional daily trip traffic volumes in the environment are sufficiently low that the induced truck movements per hour will have a less than minor effect on the traffic flow in the network.

To ensure the safe and efficient operation of the activity and to minimise the impact on the surrounding roading network the following management strategy is proposed:

- If the combined width of two of the widest truck units in the fleet is close or greater than the available carriageway width at any section of the route, then this issue should be investigated prior to material transport. Possible mitigation measures include all truck units to be in communication using two-way radio to avoid trucks passing on the narrow sections and implementing suitable operational control such as priority for one approach while the other direction gives way. It is also suggested that the same pool of drivers are utilised throughout the project period that will become familiar and comfortable with the routes.
- Engine braking should be discouraged along the route where possible.

In conclusion, provided the above management strategy is implemented, the effects on the surrounding roading network are expected to be less than minor and the surrounding road network will continue to operate in a safe and efficient manner. Therefore, the proposed activity can be supported accordingly on traffic engineering grounds.

Kind Regards

Dumindu Sundarapperuma

Transportation Engineer

+64 4 474 7339

Appendix D – Rule Assessment

Otago Regional Plan – the Coast for Otago

| Rule/ Development Control | Activity Status | Comment | Relevant Standards |
|---|-----------------------------------|---|---|
| Chapter 7 - Public Access and Occupation of Space | | | |
| <p>7.5.1.1 Occupation of the Coastal Marine Area</p> | <p>Permitted activity</p> | <p>Cannot comply – the proposed works will restrict public access and include the use of vehicles during the construction period.</p> | <p><i>Any activity or event which restricts or excludes public access from land of the Crown within the coastal marine area is a permitted activity provided:</i></p> <ul style="list-style-type: none"> <i>a) The restriction or exclusion is for a period not exceeding:</i> <i>b) 31 Days in any one calendar year if the activity is Navy defence operations in Otago Harbour; or</i> <i>c) Three days in any 12 month period for any other activity; and</i> <i>d) In the case of restricted access, the restriction is limited to an area of one hectare or less; and</i> <i>e) In the case of exclusion of access, the exclusion is limited to an area of 0.5 hectares or less; and</i> <i>f) The disturbance of the foreshore or seabed is confined within the perimeter of the area of occupation and, when completed, the foreshore or seabed is smoothed flat with no visible depressions greater than 0.5 metres in depth; and</i> <i>g) The activity or event does not occur in a coastal protection area; and</i> <i>h) The activity or event does not include the use of vehicles other than for: <ul style="list-style-type: none"> <i>i. The purposes of search and rescue operations; or</i> <i>ii. The launching of ships; or</i> <i>iii. Other emergency situations; or</i> <i>iv. Navy defence operations in Otago Harbour; and</i> </i> <i>i) Public notice of the activity or event is first given in a local newspaper at least seven days beforehand.</i> |
| <p>7.5.1.3 Occupation of the Coastal Marine Area</p> | <p>Discretionary activity</p> | <p>Not applicable – public access will not be excluded to an area over 10 hectares, the</p> | <p><i>Any activity involving occupation of the coastal marine area is a discretionary activity if it:</i></p> <ul style="list-style-type: none"> <i>a) Would exclude or effectively exclude public access from areas of the coastal marine area over 10 hectares (except where such exclusion is</i> |

| Rule/ Development Control | Activity Status | Comment | Relevant Standards |
|--|------------------------|---|--|
| | | length the beach is under 300m and any occupation is well under 50 hectares. | <p><i>required in commercial port areas for reasons of public safety or security);</i> <i>or</i></p> <p>b) <i>Would exclude or effectively exclude the public from more than 316 metres along the length of the foreshore; or</i></p> <p>c) <i>Would involve occupation or use of areas greater than 50 hectares of the coastal marine area and such occupation or use would restrict public access to or through such areas.</i></p> |
| 7.5.1.4 Occupation of the Coastal Marine Area | Permitted activity | Cannot comply – the proposed activities are not permitted under the identified rules | <i>The occupation of the coastal marine area by any structure which is identified as a permitted activity by rules 8.5.1.1, 8.5.1.2, 8.5.1.3, 8.5.1.6, 8.5.1.7, 8.5.2.1, 8.5.2.2, 8.5.2.3, or 8.5.4.1 is a permitted activity.</i> |
| 7.5.1.5 Occupation of the Coastal Marine Area of the Coastal Marine Area | Discretionary activity | Resource consent required – the occupation of the CMA by the rock groynes are not provided for by the rules identified in the relevant standard. | <i>Except as provided for by rules 7.5.1.1, 7.5.1.2, 7.5.1.3, or 7.5.1.4 any activity involving occupation of land of the Crown within the coastal marine area is a discretionary activity.</i> |
| Chapter 8 – Structures and Signs | | | |
| 8.5.1.4 Erection or placement of a structure or sign | Discretionary activity | Not applicable – the groyne structures will not contain areas of the coast (access still able around the structures, they do not run parallel to the | <p><i>Any activity involving the erection or placement of a structure or structures in the coastal marine area is a discretionary activity if:</i></p> <p>a) <i>It would impound or effectively contain 4 hectares or more of the coastal marine area; or</i></p> |

| Rule/ Development Control | Activity Status | Comment | Relevant Standards |
|--|------------------------|--|---|
| | | coast, they do not extend over 100 metres in length and are not used for storage. | <p>b) <i>It is solid (or presents a significant barrier to water or sediment movement) and when established on the foreshore or seabed would extend 300 metres or more in length more or less parallel to the line of mean high water springs (including separate structures which total 300 metres or more contiguous); or</i></p> <p>c) <i>It is solid (or presents a significant barrier to water or sediment movement), and it is sited obliquely or perpendicular in horizontal projection to the line of mean high water springs, and is in horizontal projection 100 metres or more in length; or</i></p> <p>d) <i>It is for the storage or containment of any petroleum, petroleum products, or contaminants, in quantities greater than 50,000 litres.</i></p> |
| 8.5.1.9 Erection or placement of a structure or sign | Discretionary activity | Resource consent required – the rock groynes structures are not provided for by the rules identified in the relevant standard. | <i>Except as provided for by Rules 8.5.1.1 to 8.5.1.6, 8.5.1.8 and 8.5.1.10, any activity involving the erection or placement of a structure or structures in, on, under, or over any foreshore or seabed is a discretionary activity.</i> |
| Chapter 9 – Alteration of the Foreshore and Seabed | | | |
| 9.5.3.2 Disturbance of the foreshore and seabed | Permitted activity | Can comply – dredging to provide sand for the project will be undertaken within the thresholds of the permitted activity standards and the existing resource consent | <p><i>The disturbance of the seabed for the purposes of maintenance dredging of the existing channel and berths within Otago Harbour is a permitted activity provided:</i></p> <p>a) <i>It is for the purposes of maintaining water depth in the following areas to the following depths:</i></p> <p>i. <i>The upper berths and swinging areas: 10 metres</i></p> <p>ii. <i>The upper channel: 8.5 metres</i></p> |

| Rule/ Development Control | Activity Status | Comment | Relevant Standards |
|---|------------------------|---|--|
| | | (Resource Consent 2010.193) also held by Port Otago. | <ul style="list-style-type: none"> iii. Port Chalmers berths and swinging areas: 14.5 metres iv. Lower channel: 13 metres; and <p>b) It is for the purposes of ensuring the safe and convenient navigation of ships in navigation channels and at berthing and mooring facilities.</p> |
| 9.5.3.3 Disturbance of the foreshore and seabed | Discretionary activity | Not applicable – the sand deposited on the beach will be less than 50,000m ³ , the site is less than 4 hectares and works impact less than 1000m of foreshore or seabed. | <p>Except as provided for by 9.5.3.2 any disturbance of foreshore or seabed in the coastal marine area, in any 12 month period, is a discretionary activity if:</p> <ul style="list-style-type: none"> a) It is in volumes greater than 50,000 cubic metres; or b) It is extracted from areas equal to or greater than 4 hectares; or c) It extends 1,000 metres or more over foreshore and seabed. |
| 9.5.3.6 Disturbance of the foreshore and seabed | Discretionary activity | Resource consent required – the disturbance from construction of the rock groynes and deposition of sand is not provided for by the rules identified in the relevant standard. | Except as provided for by Rules 9.5.3.1 to 9.5.3.5 any disturbance of foreshore or seabed is a discretionary activity. |
| 9.5.4.3 Deposition of sand, shell, shingle, or other natural material | Discretionary activity | Resource consent required – the deposition of sand is not provided for by the rules identified in the relevant standard. | Except as provided for by Rules 9.5.4.1, any activity involving the deposition of sand, shell, shingle, or other natural material in the coastal marine area is a discretionary activity. |
| Chapter 10 - Discharges | | | |
| 10.5.6.1 Discharge of water or other contaminants | Permitted activity | Cannot comply – the relevant standard can be met for the dredging discharge which is specifically authorised, but. The water and sediment laden | <p>Except as provided for by Rules 10.5.1.1 through to 10.5.5.8, the discharge of water or contaminants to the coastal marine area is a permitted activity if the discharge is of:</p> <ul style="list-style-type: none"> a) Water which will not change the natural temperature of the receiving waters, after reasonable mixing, by more than 3o Celsius; or |

| Rule/ Development Control | Activity Status | Comment | Relevant Standards |
|---|---------------------------|---|---|
| | | water discharged to the beach is not authorised by the first clause despite not increasing the natural temperature of the receiving water as it will contain water and sediment (sand) and only water is authorised by (i). | <ul style="list-style-type: none"> b) <i>Non-toxic tracer dye; or</i> c) <i>Cooling water free of process or waste substances and which would not change the natural temperature of the receiving waters, after reasonable mixing, by more than 3o Celsius; or</i> d) <i>Continually flowing water which has been used for holding live sea organisms and which has had no other contaminant added to it; or</i> e) <i>Water discharged from the maintenance dredging of the Otago Harbour as permitted by 9.5.3.2.</i> |
| 10.5.6.2 Discharge of water or other contaminants | Discretionary activity | Resource consent required – discharge activity not provided for by rule 10.5.6.1. | <i>Except as provided for by 10.5.6.1, the discharge of water or contaminants into the coastal marine area is a discretionary activity.</i> |

Second Generation Dunedin City District Plan (2GP)

| Rule (Activity status table) | Activity Status | Comment | Performance Standards |
|---------------------------------------|-----------------------|--|--|
| Chapter 4 Temporary Activities | | | |
| 4.5.4.2 Construction | Permitted activity | Will comply – noise and vibration will meet the limits contained in the relevant performance standards. | <p>4.5.4 Noise</p> <p>4.5.4.1 Construction</p> <ul style="list-style-type: none"> a) <i>Construction must not exceed the following limits and will be measured and assessed in accordance with NZS6803:1999 Acoustics Construction Noise:</i> <p><i>Construction noise received in residential zones and dwellings in rural and rural residential zones, and buildings housing any noise sensitive activities in any other zone</i></p> |

| Rule (Activity status table) | Activity Status | Comment | Performance Standards | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------------|--------------------|---------------------------|---|------------------|------------------|------------------------------|------------------|-----------------------------|--|--|--|---------------------------|--|------------------------------|--|-----------------------------|--|------------------|------------------|------------------|------------------|------------------|------------------|----------|--------------------|----|----|----|----|----|----|--------------------|----|----|----|----|----|----|--------------------|----|----|----|----|----|----|--------------------|----|----|----|----|----|----|-----------|--------------------|----|----|----|----|----|----|--------------------|----|----|----|----|----|----|-----------------------------|--------------------|----|----|----|----|----|----|--------------------|----|----|----|----|----|----|
| | | | <table border="1" data-bbox="994 347 1850 807"> <thead> <tr> <th rowspan="3">Time of Week</th> <th rowspan="3">Time Period</th> <th colspan="6">Duration of work</th> </tr> <tr> <th colspan="2">1. Typical Duration (dBA)</th> <th colspan="2">2. Short-term Duration (dBA)</th> <th colspan="2">3. Long-term Duration (dBA)</th> </tr> <tr> <th>L_{Aeq}</th> <th>L_{max}</th> <th>L_{Aeq}</th> <th>L_{max}</th> <th>L_{Aeq}</th> <th>L_{max}</th> </tr> </thead> <tbody> <tr> <td rowspan="4">Weekdays</td> <td>1. 6.30am - 7.30am</td> <td>60</td> <td>75</td> <td>65</td> <td>75</td> <td>55</td> <td>75</td> </tr> <tr> <td>2. 7.30am - 6.00pm</td> <td>75</td> <td>90</td> <td>80</td> <td>95</td> <td>70</td> <td>85</td> </tr> <tr> <td>3. 6.00pm - 8.00pm</td> <td>70</td> <td>85</td> <td>75</td> <td>90</td> <td>65</td> <td>80</td> </tr> <tr> <td>4. 8.00pm - 6.30am</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> </tr> <tr> <td rowspan="2">Saturdays</td> <td>5. 7.30am - 6.00pm</td> <td>75</td> <td>90</td> <td>80</td> <td>95</td> <td>70</td> <td>85</td> </tr> <tr> <td>6. 6.00pm - 7.30am</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> </tr> <tr> <td rowspan="2">Sundays and Public Holidays</td> <td>7. 7.30am - 6.00pm</td> <td>55</td> <td>85</td> <td>55</td> <td>85</td> <td>55</td> <td>85</td> </tr> <tr> <td>8. 6.00pm - 7.30am</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> <td>45</td> <td>75</td> </tr> </tbody> </table> <p data-bbox="1039 820 1957 1254"> b) <i>Vibration from construction must not exceed a maximum particle velocity measured on any foundation of an adjacent building on another site, or the same site if different ownership, of 25mm/second for commercial buildings or 10mm/second for buildings housing noise sensitive activities.</i> c) <i>Activities that contravene this performance standard by less than 5dB L_{Aeq} (15 min) are discretionary activities.</i> d) <i>Activities that contravene this performance standard by 5dB L_{Aeq} (15 min) or more are non-complying activities.</i> e) <i>For the purposes of Rule 4.5.4.1 "short-term duration" means construction work at any one location for up to 14 calendar days per project; "typical duration" means construction work at any one location for more than 14 calendar days but less than 20 weeks per project; and "long-term duration" means construction work at any one location with a duration exceeding 20 weeks per project.</i> </p> | Time of Week | Time Period | Duration of work | | | | | | 1. Typical Duration (dBA) | | 2. Short-term Duration (dBA) | | 3. Long-term Duration (dBA) | | L _{Aeq} | L _{max} | L _{Aeq} | L _{max} | L _{Aeq} | L _{max} | Weekdays | 1. 6.30am - 7.30am | 60 | 75 | 65 | 75 | 55 | 75 | 2. 7.30am - 6.00pm | 75 | 90 | 80 | 95 | 70 | 85 | 3. 6.00pm - 8.00pm | 70 | 85 | 75 | 90 | 65 | 80 | 4. 8.00pm - 6.30am | 45 | 75 | 45 | 75 | 45 | 75 | Saturdays | 5. 7.30am - 6.00pm | 75 | 90 | 80 | 95 | 70 | 85 | 6. 6.00pm - 7.30am | 45 | 75 | 45 | 75 | 45 | 75 | Sundays and Public Holidays | 7. 7.30am - 6.00pm | 55 | 85 | 55 | 85 | 55 | 85 | 8. 6.00pm - 7.30am | 45 | 75 | 45 | 75 | 45 | 75 |
| Time of Week | Time Period | Duration of work | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1. Typical Duration (dBA) | | | | 2. Short-term Duration (dBA) | | 3. Long-term Duration (dBA) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | L _{Aeq} | L _{max} | L _{Aeq} | L _{max} | L _{Aeq} | L _{max} | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Weekdays | 1. 6.30am - 7.30am | 60 | 75 | 65 | 75 | 55 | 75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2. 7.30am - 6.00pm | 75 | 90 | 80 | 95 | 70 | 85 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3. 6.00pm - 8.00pm | 70 | 85 | 75 | 90 | 65 | 80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4. 8.00pm - 6.30am | 45 | 75 | 45 | 75 | 45 | 75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Saturdays | 5. 7.30am - 6.00pm | 75 | 90 | 80 | 95 | 70 | 85 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6. 6.00pm - 7.30am | 45 | 75 | 45 | 75 | 45 | 75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sundays and Public Holidays | 7. 7.30am - 6.00pm | 55 | 85 | 55 | 85 | 55 | 85 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8. 6.00pm - 7.30am | 45 | 75 | 45 | 75 | 45 | 75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Rule (Activity status table) | Activity Status | Comment | Performance Standards |
|---|-----------------------------------|---|--|
| Chapter 8A Earthworks | | | |
| 8A.3.2(2) Earthworks – small scale Development of: Access tracks Laydown area Stockpiles | Not applicable | Works do not fall within the development and performance standards to be considered 'small scale' | The proposed works do not fit within the criteria of earthworks – small scale as the thresholds within Rule 8A.5.1.4 and 8A.5.1.5 are exceeded: <ul style="list-style-type: none"> - Works will exceed 25m² within 5m of MHWS. - Works will exceed 20m² of fill within the hazard 3 overlay. |
| 8A.3.1 Earthworks – large scale | Restricted discretionary activity | As the works cannot be considered earthworks – small scale, the works fall within Rule 8A.3.1. | Setbacks from coast and water bodies (must comply with Rule 10.3.3. Rule 10.3.3 - In all zones, earthworks - large scale, must be set back a minimum of: <ul style="list-style-type: none"> - 20m from mean high water springs (MHWS). Earthworks will be located within 20m of MHWS and therefore contravenes this standard. However, in accordance with Rule 8A.3.1.4 - If a restricted discretionary activity does not meet one or more performance standards, then the activity status remains restricted discretionary, unless otherwise indicated in the performance standard. The activity therefore remains as a restricted discretionary activity. |
| Chapter 10 Natural Environment | | | |
| 10.3.2.3 Protected species (indigenous vegetation clearance) | Restricted discretionary activity | The proposal includes the removal of a small amount of indigenous vegetation, namely pohuehue vineland, to construct access tracks. This removes some habitat of the southern grass skink (<i>Oligosoma</i> aff. <i>polychroma</i>) | In the rural, rural residential and recreation zones, indigenous vegetation clearance must not occur where the following are present in the area to be cleared: <ul style="list-style-type: none"> - any of the threatened plant species listed in Appendix 10A.1; - any mature examples (greater than 15 years old) of the important indigenous tree species listed in Appendix 10A.3; or - any threatened indigenous fauna species listed in Appendix 10A.2. |

| Rule (Activity status table) | Activity Status | Comment | Performance Standards |
|---|---|---|--|
| | | Clade 5) which is a species listed in Appendix 10A.2. | |
| 10.3.3 Setback from Coast and Water Bodies | Restricted Discretionary Activity | Works will be located within 20m of MHWS. | In all zones, ...earthworks - large scale....must be set back a minimum of: - 20m from mean high water springs (MHWS) |

Appendix E – Ecological Impact Assessment



Port Otago Ltd

Ecological Impact
Assessment for
Te Rauone Beach
Management Scheme
(Revised)

April 2020



Port Otago Ltd

Ecological Impact Assessment for Te Rauone Beach Management Scheme (Revised)

Prepared for Andy Pullar, Port Otago Ltd

by

Shannon Goodwin, BSc; Mandy Tocher, PhD

Peer Reviewed by Mark Sanders, PhD

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Document version : 03/04/2020 Final

Cover page: Te Rauone Beach, northern end looking south over heavily eroded dune habitat.

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1. Project Background

Port Otago Ltd (POL) plan to undertake a beach management scheme (the 'scheme') within the Te Rauone Recreation Reserve and adjacent beach and foreshore to improve amenity. POL propose to build three rock groynes, perpendicular to the shoreline, to help reduce erosion of the beach and adjacent Dunedin City Council (DCC) reserve land (Figure 1). It is proposed that sediment will be introduced to site, firstly by trucking sediment onto the beach, and following this, intermittent "topping up" will occur by pumping sediment ashore from the POL dredge boat, Takutai. The following ecological assessment supports an application for resource consent, relating to the POL proposal at Te Rauone beach.

2. Site Context

Te Rauone Beach is a sandy beach near the entrance of Otago Harbour, at Harington Point (Figure 1). At high-tide the beach is narrow, especially at the northern end, with only a few metres remaining exposed at the foot of the foredunes. The northern part of Te Rauone beach, the part subject to the beach management scheme, lies entirely within the 2.5 ha Te Rauone Recreation Reserve, situated at 935 Harington Point Road. Together with the Te Rauone Esplanade Reserve, the Te Rauone Recreation Reserve forms the Te Rauone Beach Domain (referred to as the "Domain" in the remainder of this Ecological Assessment (EA)). These reserves are all administered by the Parks and Recreation Department of the DCC. Although the beach has experienced a long history of sand loss and realignment, initially a likely consequence of large-scale vegetation clearance by whalers, in more recent times serious erosion has occurred causing large areas of the beach and adjacent Domain to be lost to the harbour. Erosion is particularly pronounced in the northern end of the beach (Figure 2), where the proposed POL beach management scheme is to be undertaken.

The Domain is not subject to a stand-alone management plan, but the reserve is included in the Otago Harbour Reserves Management Plan (2006) which provides background information on its landscape, cultural, recreation and ecological values, along with detailing management issues of the reserve, including erosion and beach access. The enhancement of natural beach processes is also highlighted in this plan. The Otago Harbour Reserves Management Plan (2006) contains some suggestions for ecological enhancement of the adjacent DCC Domain; including new plantings of native species, and providing interpretation panels on the wildlife that frequent the reserve and their threats (e.g. penguins and dogs). The Domain is also subject to the DCC Coastal Dune Reserves Management Plan (2010), a land-based plan that includes those reserves located in the coastal dune environment, where the principal purpose is to provide coastal protection while simultaneously providing for recreational opportunities. The key issues identified in this plan for the Te Rauone Beach Reserve are safety of beach access for visitors, and erosion.



Figure 1: Site location of the Te Rauone Beach nourishment scheme showing footprint (pink shading) and location of the proposed groynes (cream shaded areas projecting into the harbour from the beach). Indicative locations of impact transects, that were surveyed for benthic fauna and flora, are shown in blue (see Figures 5 and 6 below for a detailed sampling map. Base photo supplied by Port Otago Ltd. The proposed location of the backhoe dredge, Takutai, that will pump sediment onshore is also shown.



Figure 2: Aerial photographs from Google Earth of the northern end of Te Rauone beach showing the extent of vegetation in 2004 (left photograph) compared with the same stretch of beach in 2019 (right photograph). The red line indicates the approximate position of the mean high-water springs line in 2019 that has moved inland up to c. 65 m. Some of the large trees over the northern part of the reserve (yellow circle) that are now only stumps on the beach/foreshore.



Figure 3: Aerial photograph showing the site plan for the scheme including public and construction access tracks along with a 0.17 ha site establishment area on private land over the northern part of the site. Image supplied by BECA.

3. Scope of Assessment

This ecological assessment (EA) is limited to the terrestrial and marine benthic communities of the scheme footprint; namely the foredunes, beach and soft-sediment marine intertidal environments, and a 0.17 ha site on private land proposed for construction access and site establishment/storage (Figure 3). The overriding objective of this EA is ***to characterise the existing environment at a level commensurate with the anticipated actual and potential effects of the scheme on this environment.***

4. Context of the Ecological Assessments

Marine Benthic Communities

Sampling and Survey Rationale

Dr Brian Stewart, Ryders' Senior Marine scientist was consulted on, and endorsed the chosen methods for sampling benthic fauna and flora detailed in this EA. We carried out sampling (of both the surface, or epifauna; and the fauna inside the sediment, or infauna) to enable us to characterise the marine benthic community existing environment, pre-scheme, with which to base our effects assessment, and to inform adaptive management of these effects. We had a particular interest in determining the presence of "protected species and areas of significance", to meet the preliminary information requirements of DOC (received July 2019; see Appendix 1). In addition, our assessment was also structured to enable us to monitor any changes in this environment through time, both during (for seagrass beds) and after the scheme is constructed. The pre-scheme assessment had the purpose of allowing us to validate, retrospectively, our effects assessment; and with regards to effects management, to allow for an adaptive management approach, especially important for seagrass beds outside the scheme footprint, but also important for other values within the footprint (see Section 10 below).

DOC commented on the likely impact of the scheme (without having seen the full AEE subsequently submitted to council), generally, by stating:

"On the face of it and from the information we have received we see a lot of benefits to the work being done, such as a place for sea lions to breed and rest, a place for sea birds to roost, introduction of an ecological rocky coastline that has been lost, a stable sandy beach in that area and a way to mitigate the issues we face from the impacts of climate change".

In terms of the anticipated impacts of the scheme on the marine benthic communities, DOC indicated an interest only in "protected species and areas of significance (such as the benthic environment)", and stated:

“The Department does not require in-depth detail on this matter, i.e. exactly what type of sea worm may be impacted in the benthic environment but generally how such work would impact/change the environment both during and after the works are completed”.

See Section 8 below for our full effect’s assessment relating to the marine benthic communities.

Marine Benthic Species & Life Stages Vulnerable to Sediment Deposition/Suspension/Disturbance

The Otago Harbour experiences heavy sediment loading during flood and heavy rainfall events, and as such, it is likely that the benthic communities are adapted to naturally turbid conditions. Lohrer *et al.* 2006¹ stated that muddy plumes consisting of terrigenous sediment, resulting from major rain events, have been observed far offshore from the Otago coastline. As a result, Lohrer *et al.* 2006 found that offshore suspension feeding organisms have adapted to high suspended sediment loads in naturally turbid areas, compared to those that are further offshore in clearer water. As the erosion observed at Te Rauone is relatively fast occurring, it is likely to be a turbid area, naturally.

To date, there are no turbidity limits set by Otago Regional Council for soft bottom beaches or estuaries in Otago, and such limits are absent elsewhere in New Zealand too. Any information regarding sediment loading that is available is typically confined to harbour dredging, relying on six hourly or two-week moving averages. Turbidity measures recorded for the Otago dredging channel have been known to regularly reach >80 mg/l at Acheron Head², and in Tauranga harbour, turbidity has been measured at levels greater than 36 mg/l but was generally lower than 4 mg/l³.

The turbidity figures noted above are useful context to show the massive range in turbidity experienced within two New Zealand Harbours, but there is limited information available on the effects of suspended sediments on local marine species. This is also true for any New Zealand marine species. James *et al.* (2009)⁴ and Warren *et al.* (2016)⁵ have attempted to summarise published literature that included both laboratory and field observations for some soft bottom organisms in New Zealand; a summary table from this work is work is included

¹Lohrer, A. M., Hewitt, J. E., & Thrush, S. F. (2006). Assessing far-field effects of terrigenous sediment loading in the coastal marine environment. *Marine Ecology Progress Series*, 315, 13-18.

²Berthelsen, A. (2016). Summary of turbidity data for Otago Harbour: 2015/2016. Prepared for Port Otago Ltd, Cawthron Report No. 2903.

³Stewart, B. (2018). Comment by Dr. Brian Stewart in response to minute #7 of hearing commissioners (turbidity thresholds).

⁴James, M., Probert, K., Boyd, R. and Sagar, P. (2009). Biological resources of Otago Harbour and offshore: assessment of effects of proposed dredging and disposal by Port Otago Ltd. Client report HAM2008-152 prepared for Port Otago Ltd by NIWA.

⁵Warren, P., Sharp, D., Guccione, D. (2016). Rapid ecological assessment of sponge and associated marine communities post dredging in Tauranga Harbour entrance. Report #2016-02-TGAH prepared for refining New Zealand by Toi Ohamai Institute of Technology

below that shows varied responses to sediment across species with New Zealand cockles (*Austrovenus stutchburyi*), for example, being relatively robust (Table 1).

Hewitt & Norkko (2007)⁶ have concluded that New Zealand cockles tolerate suspended sediment at levels up to 400 mg/l, and even higher in field observations, before organism condition started to decline. In the same report, consistently high sediment loadings dominated by clays were found to have a significant impact on cockles, with juveniles more affected than adults. It should be noted that clays are not a feature of sediments to be used for the re-nourishment scheme at Te Rauone, but are included here to acknowledge their presence in the marine environment and the effects they can have.

Table 1: Effects of sediment loads on local New Zealand marine species. Unless otherwise stated, sediment concentrations are expressed as mg/l. Data were compiled from a literature search and the data contained in James *et al.* (2009) and Warren *et al.* (2016). As an example, pipis demonstrated changes in behaviour during sediment loads of between 15-700 mg/l. Note: sediment in the Otago Harbour channel regularly reaches >80 mg/l during dredging.

| Species/common name | Effects | | | |
|----------------------|-----------|----------------------|---------|------------|
| | Behaviour | Growth and Condition | Death | Duration |
| Pipis | 15-700 | 15-75 | Unknown | 2-14 days |
| Cockles | 150-550 | 350 | Unknown | 14 days |
| Mussels | 100-1000 | 26 | Unknown | 3-13 days |
| Oysters | 10-600 | 15 | 50 | Unknown |
| Scallops | 25-600 | 25 | 50-600 | <1-4 days |
| Snapper | 160 NTU | Unknown | Unknown | Unknown |
| Fish eggs and larvae | 20-250 | 100-250 | 20-750 | Unknown |
| Bivalve larvae | Unknown | 750-1000 | 1000 | 2 days |
| Kina and paua larvae | Unknown | 35 | 350 | 9 days |
| Seagrass | N/A | 15 | >75 | 30 days |
| Horse mussels | 100-800 | 80-800 | Unknown | <1-11 days |
| Snails | >650 | Unknown | Unknown | Unknown |
| Wedge Shell | 80-300 | Unknown | 300 | 8 |
| Tube building worm | 80-310 | Unknown | Unknown | >14 |
| Heart urchin | 80 | Unknown | 80 | 14 |

Distribution of New Zealand Cockles in Otago Harbour

Cockles world-wide including the Otago Harbour have specific sediment requirements, and tend to occur in the highest densities in areas of the harbour where moderate levels of mud are contained within the sediment. These sediment conditions are generally (but not always) found at the mid- to low tide areas of a beach⁷. For this reason, the highest densities of cockles

⁶Hewitt, J.E. and Norkko, J. (2007). Incorporating temporal variability of stressors into studies: An example using suspension-feeding bivalves and elevated suspended sediment concentrations. *Journal of Experimental Marine Biology and Ecology* 341: 131-141.

⁷Li, B., Cozzoli, F., Soissons, L. M., Bouma, T. J., & Chen, L. (2017). Effects of bioturbation on the erodibility of cohesive versus non-cohesive sediments along a current-velocity gradient: A case study on cockles. *Journal of experimental marine biology and ecology*, 496, 84-90.

are oftentimes found within the *Zostera* (seagrass) beds that have broadly similar habitat requirements to cockles.

Further to this, “significant cockle beds of the Otago Harbour (referred to in relation to CPA17 of The Regional Plan: Coast for Otago), are those with the highest densities which occur within areas of their preferred sediment. We have adopted this view in the absence of a definition of “significant cockle beds” in the The Regional Plan: Coast for Otago.

Preferred sediment for cockles is not known to be well represented over the Te Rauone scheme footprint (pers. obs., and Dr Brian Stewart pers. comm. March 2020); instead, Te Rauone beach sediments can be characterised as having erodible sediments that offer at best marginal habitat for cockles⁸. With this context, we did not expect to find significant cockle beds at Te Rauone in our benthic samples, and designed our sampling regime accordingly (see Section 7 below).

Effects of Suspended Sediment on Zostera (seagrass) beds

It is estimated that seagrass beds cover approximately 32 ha of the Otago Harbour⁹ with coastal erosion known to contribute significantly to seagrass loss¹⁰. Seasonally in Otago Harbour, there is a clear pattern in seagrass biomass with maximum biomass occurring in early autumn after spring and summer growth, and minimal biomass occurring at the end of winter and early spring following diebacks that occur during colder winter conditions where lower light levels are experienced¹¹.

There are existing robust monitoring data available for seagrass beds of the Otago Harbour, including Te Rauone beach. For example, POL has undertaken regular monitoring of seagrass beds in Otago Harbour since 2013. More specifically, aerial photographs of Te Rauone beach have been undertaken in December 2015, April 2016, June 2016, October 2016, February 2017, August 2017, April 2018, and June 2019 and are attached here as Appendix 2. These photographs unequivocally demonstrate the lack of seagrass beds within or very close to the scheme footprint. Sparse seagrass does occur, however, seaward of the scheme footprint, and beds occur over the southern area of Te Rauone beach (referred to here as the “southern sea grass beds”; Figure 5).

Seagrass requires stable sediment, and beds are most susceptible to fine suspended sediment, the type easily moved/removed by tidal action of the type and severity experienced over the scheme footprint. Indeed, the tidal action that disturbs sediments over the scheme

⁸Adkins, S. (2012) Population biology and restoration of cockle beds. PhD thesis, University of Canterbury, New Zealand.

⁹Stewart, B. (2017) Key habitats- Otago Harbour. Unpublished summary report prepared for Port Otago Limited by Ryder Consulting.

¹⁰Short, F.T., Neckles, H.A. (1999) Review: The effects of global climate change on seagrasses, *Aquatic Biology*: 63, 169-196.

¹¹Ismail, N. (2001). Ecology of eelgrass, *Zostera novazelandica* (Setchell), in Otago Harbour, Dunedin, New Zealand. PhD thesis, University of Otago, New Zealand.

footprint to the point that seagrass fails to establish, is the same tidal action that is expected to move/remove suspended sediment created by the re-nourishment process. Tidal cycling of water is known to resuspend sediment and transport some of the substrate away; finer sediments are easily suspended, with the rate of resuspension decreasing as particulate size increases.

Previous literature on the effects of suspended sediment loading on seagrass beds has remained largely qualitative. James *et al.* 2009¹² has provided some data showing that seagrass growth and condition deteriorates when sediment suspension is raised above 15mg/l, and death of seagrass beds can occur at >75mg/l, when concentrations are sustained for a period of 30 days. In addition, a NIWA client report prepared for the Northland regional council identifies “*increased suspended sediment levels (especially of fine material) contributing to seagrass loss*”¹³.

The long-term monitoring of seagrass beds in the Otago Harbour provides valuable and relevant context with which assess the anticipated effects of the Te Rauone scheme on seagrass beds, both inside and outside of the scheme’s footprint. Based on decades of seagrass monitoring in the Otago Harbour in response to POL dredging operations¹⁴, Dr Brian Stewart holds the view that Otago Harbour seagrass beds can tolerate accretion of sediment up to, but not exceeding, 10 cm per day (Dr Brian Stewart pers. comm. March 2020). Accretion of this amount is regarded as severe, and as an example, is the extent and quantity expected should sediment be deposited directly on the seagrass beds, an action that will not occur in relation to the POL scheme at Te Rauone.

At Te Rauone over the proposed footprint, and as noted above, seagrass beds are known to be extremely sparse due to the instability of the soft substrate,¹⁵ and this observation was borne out by our sampling (see Section 7 below). The area immediately adjacent to the scheme footprint (the “control” site described below), also has sparse beds, for the same reason. These observations, coupled with the background research that has failed to show adverse effects on seagrass beds of the harbour as a result of many decades of dredging, helped inform our sampling and the level of management proposed for seagrass beds, both inside, directly adjacent and well outside the scheme footprint (within the southern seagrass beds of CPA17).

¹²James, M., Probert, K., Boyd, R. and Sagar, P. (2009). Biological resources of Otago Harbour and offshore: assessment of effects of proposed dredging and disposal by Port Otago Ltd. Client report HAM2008-152 prepared for Port Otago Ltd by NIWA.

¹³NIWA client report (2004). Feasibility study to investigate the replenishment/reinstatement of seagrass beds in Whangarei Harbour - Phase 1. Prepared for Northland Regional Council. Report Number AKL2004-33.

¹⁴Stewart, B and Goodwin, S. (2018). Repeat monitoring of seagrass beds for Project Next Generation: Autumn 2018. Client report prepared for Port Otago Limited by Ryder Environmental.

¹⁵Short, F.T., Neckles, H.A. (1999) Review: The effects of global climate change on seagrasses, *Aquatic Biology*: 63, 169-196.

Terrestrial Ecology

General

Otago Harbour is a nationally important site for indigenous birds and the threatened Hooker's sea lion is an important species of sandy beaches both within the Harbour and over the wider Otago Peninsula. The harbour is a nursery area for marine species that provide food for resident and migratory bird species, including significant populations of wading birds. Te Rauone beach and nearby Weller's Rock has an important cultural history, and is used by a variety of indigenous birds and sea mammals, including over recent times, Hooker's sea lion. This is especially the case for the southern reaches of the beach, where extensive beach and tidal flat habitats persist; over the northern reaches, by contrast, coastal erosion has lessened beach habitat (see Figure 2) and tidal flats have reduced in quality as a result of the disturbance. The entire Te Rauone beach is hugely significant to local residents for its intrinsic values, as a source of kai moana, and for its value as a gathering place for whanau socialisation and recreation (e.g. horse riding).

Bird Survey

The purpose of the bird field-survey (inventory) was to collect presence-absence data on the use of the site by indigenous birds, rather than collect robust baseline monitoring data. The bird fauna of the Otago Harbour is well-known by Dunedin-based ecologists, and there is no best-practice method for surveying birds on inner harbour beaches¹⁶. The method employed (as described below in Section 6), of carrying out a slow visual and audio search along the beach, was considered to be appropriate for the habitat and the species likely to be encountered (Dr Mark Sanders, Ornithologist, Ryder Environmental pers. comm. October 2019).

Lizard Survey

As for the bird survey, the purpose of the lizard field survey (inventory) was to collect presence-absence data on the use of the site by indigenous lizards. The Department of Conservation (DOC) have produced best practice guidelines for inventory of lizards in New Zealand, including a decision tree that includes collection of presence/absence data for "distribution and inventory purposes"¹⁷.

¹⁶ <https://www.doc.govt.nz/globalassets/documents/science-and-technical/inventory-monitoring/im-toolbox-birds-introduction-to-monitoring.pdf>

¹⁷ <https://www.doc.govt.nz/globalassets/documents/science-and-technical/inventory-monitoring/im-toolbox-herpetofauna-introduction-to-monitoring.pdf>

Hooker's sea lion survey

DOC was consulted via telephone (Mr Jim Fyfe) regarding the distribution of Hooker's sea lions over the northern reaches of Te Rauone beach, and also, the possible effects of the Te Rauone development on sea lions (see Section 8 below for our effects assessment). Attempts were also made (without success) to contact the Sea Lion Trust, Dunedin, to gain further local knowledge. Stuff.co.nz was also searched for background information; and our own experience of sea lions in Otago Harbour also informed our chosen methods for survey, and effects assessment.

5. Proposed Works Over the Scheme Footprint

POL propose to implement a scheme to provide beach amenity for the Te Rauone community. This is proposed to be achieved through the management of the ongoing erosion at Te Rauone Beach Reserve, by introducing three rock groynes onto the foreshore, and replenishing sediment over the beach. A small paddock (c. 0.17 ha) on private land will be used as a site establishment/storage area, and to provide a northern access to the beach (see Figure 3). Some indigenous vegetation clearance (pohuehue vineland) will be carried out to establish construction access (Figure 3; see Section 8).

Replenishment will only focus on the northern end of Te Rauone, using sediment dredged from the Otago Harbour channel. Intermittent 'top-ups' of sediment are also proposed, but the new rock groynes have been designed to retain sediment (rather than help accumulate it), and top-ups will occur only on an as-required-basis. Some recycling of sediment onsite, is anticipated. As well as replenishing the sediment, some foredune sculpturing is proposed to provide a suitable receiving environment for the introduced sediment.

Led by DCC Parks and Recreation, some restoration is also planned for the foredunes and back dunes, post-scheme works; e.g. by planting with indigenous sand-binding plants, such as pikao. This restoration work is fully independent (but hoped to be complementary) to the proposed POL scheme. Planting of dunes by DCC will help buffer the Te Rauone Recreation Reserve (Domain) from extreme erosion events; promote safer access to beach, and contribute to an enhanced beach/dune system aesthetic.

POL works to implement the scheme at Te Rauone will include:

- Some areas of the Te Rauone Recreational Reserve and Te Rauone Beach will be closed to public during construction. These areas include the proposed access ways, storage areas and where physical works are proposed (see Figure 3¹⁸).
- The creation of an access route to allow access by construction vehicles to the northern end of Te Rauone beach. Here, erosion has created a steep-sided bank c. 1.5 m high that

¹⁸Figure 3 of this report is referred to in other documents as "design plans 'Te Rauone Beach Management Scheme', 3331121-SK-002, Revision B.

impedes safe access. Creation of this access route may remove some existing indigenous vegetation (pohuehue vineland; see Section 8).

- Some land-based re-nourishment to reduce erosion and provide a base of sediment prior to the sea-based beach nourishment being undertaken. It is estimated that c. 200 truckloads (1200 m³) of dredged sediment will be placed above MHWS over the northern part of the beach, where the erosion is worst¹⁹.
- Installation of 3 rock groynes (70-80 m long), at approximate right angles to the existing beach, using high-grade rock boulders²⁰ likely to be placed by an excavator with a grapple arm.
- Use of a c. 0.17 ha area of private land, adjacent to Te Rauone Recreation Reserve, as a site establishment/storage/access area. A storage area maybe required for temporary storage of boulders, and for parking of works vehicles.
- The creation of a middle-beach 4.5 m access route to beach, joining to a track along the dunes to the northern beach access point/site establishment area. This track will be placed over an existing access track, and clearings, to avoid lizard habitat and existing indigenous vegetation as far as practical (see Figure 3 and Section 8).
- Potential removal of 1 mature *Pinus* spp. tree and/or the removal of low branches from 1 *Pinus* spp. tree and 1 *Eucalyptus* spp. tree (to allow access to beach by construction vehicles).
- Removal of approximately twelve existing tree stumps over the northern part of the scheme footprint. These pose a shipping hazard over the longer-term as erosion will eventually cause them to break away from the beach. The presence of these stumps may also affect the even retention of sediment, post-works. Some stumps have already been eroded into the sea (see Figure 4).
- Grading of the landward edge of the beach berm.
- Introduction of c. 34,000 m³ of sediment at the completion of the works, along the entire length of the scheme footprint (shown in Figure 1). This sediment will be pumped directly from the backhoe dredge, Takutai, which will be utilised as a platform to pump sediment ashore. It will sit on its spuds (piles lowered and raised to position the dredge) on the port side of the channel, at Harington Bend.

¹⁹Within the AEE accompanying POLs application for resource consent, the supply and placement of sand/sediment for the Te Rauone beach management scheme will be discussed (Andy Pullar pers. comm. 2019). The trigger/threshold that will require POL to introduce new sand/sediment, post works, will also be described in the AEE, and informed by monitoring proposed therein. The sand will be sourced from the Harington Bend port side claim, as sand in that location has a suitable grain size (similar to that found on Te Rauone Beach) and is naturally clean.

²⁰The source of rocks will be a local quarry.

On-going Maintenance & Operation

As noted above, POL intend to arrange for the introduction ‘top-up’ sediment on an as required basis determined by the proposed monitoring (see full AEE accompanying the consent application).



Figure 4: Up to twelve exposed tree stumps in the surf, beach and foredunes over the northern part of Te Rauone beach. Photograph: October 2019.

6. Ecological Survey Methods

Marine Benthic Communities (Existing Environment)

A field assessment of marine ecological values inside (impact sites) and outside of the scheme footprint (control sites) was carried out at low tide during overcast weather, on the 1st October 2019. Methods used for epifauna and infauna sampling were similar to those used by Stewart 2018²¹ and Paavo 2010a²².

Southern seagrass beds

Surveys did not include the area of seagrass beds over the southern end of Te Rauone beach, to the south of the footprint (shown in Figure 5). These important beds are identified in the Coastal management plan (CPA17) as an area of significance meaning physically sampling them (e.g. by taking core samples) was deemed unnecessarily damaging, especially given the extensive information readily available on the effects of sediment from dredging, on these beds (summarised above in Section 4). Sampling the seagrass bed by taking core samples

²¹Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

²²Paavo, B. (2010a). Te Rauone sampling – results reporting, amended memo.

would require extensive sampling to allow for the patchiness within a healthy bed of seagrass. The sampling required would likely be detrimental by removing shoots vital to the bed. Instead, we propose management of any potential adverse effects of the scheme on these beds via aerial survey using a drone (see Section 10 below).

Habitat under Groynes

Based on our own experience in the Otago Harbour and results from other parts of the world (e.g. a study that although carried out in higher latitudes in south Queensland, Australia by Walker *et al.* 2008²³, that has some relevance); our sampling regime was purposely designed and applied to detect any changes in benthic community species composition and relative abundance, post-scheme, on both sides of the proposed groynes (see Figure 6). Moreover, we designed our sampling of the marine benthic communities around the proposed groynes under two assumption's:

1. that the benthic community will experience complete habitat loss beneath the rock groynes; and
2. the beach infauna and epifauna over the schemes' footprint site was homogenous (across tidal heights), and assumption was validated by our sampling as well as the results of other work carried out by Dr Stewart²⁴).

In terms of loss of benthic communities under the groynes, Dr Stewart, who provided advice on this particular matter, believes that some elements of the macroinvertebrate communities may even be able to migrate out of this area as rock substrate is placed upon the shore meaning a total loss scenario may not occur.

Impact and Control Site Selection & Location

Figures 5 & 6 show a map of sampling locations (control and impact sites, and the proposed scheme footprint), in relation to existing seagrass beds. Site selection was based on a widely accepted scientific sampling protocol of a random block survey over the two separate identified areas (control and impact); one within and one outside of the scheme footprint where no physical disturbances as a result of works will occur, and both within the same beach (Figure 5 & 6). For this aspect of the EA, we assumed control and impact sites, pre- scheme, had similar soft-sediment environments. This assumption was ultimately validated by the results from our benthic community sampling²⁵ (see Section 7 below). Furthermore,

²³ Walker, Simon J., Thomas A. Schlacher, and Luke M. C. Thompson. 2008. 'Habitat Modification in a Dynamic Environment: The Influence of a Small Artificial Groyne on Macrofaunal Assemblages of a Sandy Beach. *Estuarine, Coastal and Shelf Science* 79(1):24–34.

²⁴ Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

²⁵This result was found despite the control sites being further inside the harbour, and therefore less "flushed" by the incoming tide than impact sites.

based on knowledge of the water chemistry of the Otago harbour²⁶, for example pH and temperature; we expected water chemistry to be equivalent between control and impact sites, as the distance between them was approximately 200 m (assessed from Google maps; Figure 6).

For each of the two areas (impact and control), three transects, separated into three sections relating to the tidal height: high, mid and low tide, were established. For the impact area, transects avoided the area where groynes were to be laid as these areas would not be able to be re-surveyed, post scheme but instead were situated between the proposed groyned areas (shown in Figure 1). Along each transect, the beach was divided into three tidal heights; high, mid and low tide (Figure 6).

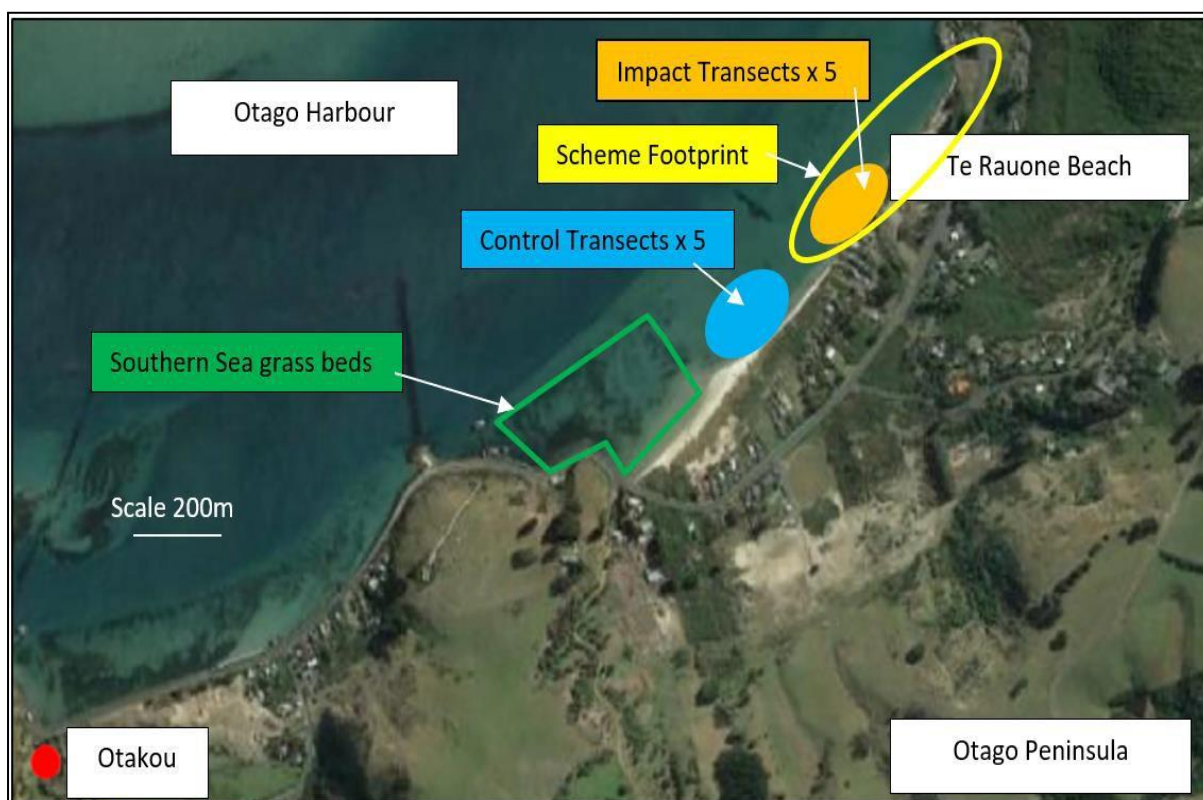


Figure 5: Overview showing indicative location of the scheme footprint (yellow oval), control and impact collection sites and seagrass beds outside of the footprint and well to the south within CPA17.

²⁶Refining NZ (2018). Memorandum of counsel on behalf of the New Zealand Refining Company Limited, Application number APP-0.37-197.01.01.



Figure 6: Location of impact (orange dots) and control (blue dots) collection sites within and outside of the scheme footprint. Yellow oval – indicative scheme footprint.

Epifauna sampling

We used standard scientific methodology when we collected samples from within the impact area and the same sampling effort was employed over the control area. Epifauna (including sea grass and unburied cockles) was sampled using a 0.25 m² quadrat, with three replicates in each tidal height 'block' (high, mid and low), making 9 samples for each of the six transects. For each quadrat, a visual survey was carried out in the field where all flora and fauna were counted and identified by a marine scientist.

Infauna sampling

Infauna (including cockles) was sampled using 0.0002 m² cores (following Stewart 2018²⁷), sieved in the field using a 1 mm mesh (following Paavo 2010a²⁸) and preserved in the laboratory using 70 % ethanol. There were 3 samples taken per tidal height, making 9 samples for each of the six transects. Identification and enumeration of infauna samples were completed by Cawthron with results collated and provided to Ryder Environmental Ltd. for reporting.

Analytical Methods

Benthic samples were collected for identification of infauna species richness and relative abundance, community structure and spatial variability. Community structure was determined by ordination, where points (each point is a sample) displayed physically close to each other are similar in terms of the species composition and abundance in the sample. An analysis of similarity was also undertaken to investigate whether there were significant differences between infauna groups; these statistics are expressed as similarity percentages where a value of 100 % indicates that the species within or between the groups are identical in terms of species present and abundance of animal's present.

The visual survey of the flora (seagrass and algae) and fauna on the surface (epifauna) produced presence/absence data for species encountered.

Terrestrial Ecology

A field assessment of terrestrial ecological values of the scheme footprint (except the storage area adjacent to the Domain) was carried out during fine weather, between 1:30-4:30 pm on October 13th 2019. The survey was conducted during an incoming tide and air temperatures ranged from 12-14°C. The survey included a mix of visual searching, whilst walking a slow transect along the length of the beach and climbing rocks to the northern point of the Te Rauone Recreation Reserve.

Indigenous Vegetation

In addition to the October 2019, a 45-minute ecology survey, targeted vegetation, was carried out during fine and very warm conditions between 12:30-1:30 pm March 7th 2020. A plant species list was formulated, and observations were made of birds, lizards and their habitat. DCC had commissioned an ecological assessment of the Te Rauone Recreation Reserve over late 2018 that was provided to us prior to the terrestrial survey taking place. Six vegetation communities were mapped in the report; namely, pohuehue vineland; exotic grassland; tree land/shrubland plantings; pikao sedge land plantings; bracken fern land and marram grassland.

²⁷Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

²⁸Paavo, B. (2010a). Te Rauone sampling – results reporting, amended memo.

The vegetation communities mapped in the report were broadly confirmed, on the ground, during the October 2019 and March 2020 terrestrial ecology surveys.

Hooker's Sea lions

As noted above in Section 4, information on the use of the northern Te Rauone beach by sea lions was sought from DOC (Mr Jim Fyffe). In addition, stuff.co.nz was searched with key word "Te Rauone" to ascertain other records of sealions frequenting the area; and the DCC commissioned ecological assessment was reviewed for sea lion records.

Birds

Birds were detected by their calls, visual sightings on the water or beach, or when resting on rock walls or flying over the beach. The search path and auditory width of the search area covered the entire area of the proposed footprint seaward of MHWS (including the transition between MHWS and the DCC Te Rauone reserve; surveyed all available bird habitats including searching adjacent mature trees for tell-tale sign of bird roosts (bird droppings and feathers on the ground and over branches, year round); was undertaken during spring²⁹, over fine weather, when bird breeding would have been detected for species of the wider area. In addition, the chosen methods were endorsed by Dr Mark Sanders, Ornithologist, Ryder Environmental, and we were careful to supplement our "snap-shot" inventory style field method with sightings from over a number of years from iNaturalist NZ and <http://nzbirdsonline.org.nz/>. Birds known to occasionally frequent Te Rauone Beach, or to roost and forage in the vicinity but that were not sighted during the field visit were extracted from iNaturalist NZ and <http://nzbirdsonline.org.nz/>.

Lizards

Handsearching and visual searches were conducted for lizards (all lizard handling was carried out under Wildlife Act authority 62386-FAU issued to Mandy Tocher). The very fact that weather conditions over the survey allowed for lizard detection, and the survey was conducted by a very experienced lizard specialist, provides substantive verification that the chosen methods were appropriate for this lizard species, at this site.

7. Ecological Values of the Footprint

Marine Benthic Communities

General

Te Rauone beach is typical of sandy beaches around Otago Harbour, with coarse sediment and minimal epifauna and flora. Filamentous brown algae were observed in many of the areas sampled and are likely a result of high sun, high nutrients and recent minimal wave action;

²⁹ A second bird survey was carried out in March 2020; this survey was a brief walk-through survey of the scheme's footprint (see Section 6).

this alga is not expected to remain in the area over the longer term (irrespective of the scheme being carried out). Epifauna was absent in all quadrats surveyed.

Seagrass beds

Seagrass beds were not detected within either the scheme footprint transects or control transects. Seagrass was, however, observed within the scheme footprint (outside of quadrats) and was extremely sparse and non-uniform in distribution. This result was consistent with previous visual surveys of Te Rauone sea grass beds³⁰ and as noted above, we did not expect to find dense and significant seagrass within the footprint an area that naturally experiences high sediment movement unsuitable for seagrass establishment and growth (e.g. NIWA client report 2004³¹). As noted above in Section 6, the extensive southern seagrass beds located to the south of the scheme's footprint were not sampled but observed as being "healthy" (but see Section 10 below for planned management of these beds).

Cockle Beds

Cockle beds (*Austrovenus stutchburyi*, also known as southern clams) are known to exist in the vicinity of Te Rauone beach; however, no cockles were observed on the sediment-surface during the visual survey, or when completing quadrat surveys (Table 2). This result is likely as a result of low tide conditions experienced during sampling, but this result was corroborated by the low incidence of cockles in our benthic samples (Table 2).

Within the infauna community (within the sediment; also see below), cockles were recorded in low numbers within the control area (Table 2 and Appendix 2) and were not recorded at all from the scheme footprint (Table 3 and Appendix 3). Although this does not indicate that they are completely absent from the footprint scheme area, it is likely that they are present in low numbers and any loss of habitat by installation of the groynes is unlikely to be significant to the overall population in Otago Harbour.

In relation to our sampling regime, which was informed by our knowledge of the distribution and abundance of cockles in Otago (e.g. Warrington, Otafelo Point, Papanui Inlet, opposite Pulling Point³², sanitation area 1804 and 1805³³, in Otago Harbour, Otago); we did not expect to find extensive cockle beds within the scheme footprint due to the extensive sediment (and shore) erosion that had occurred over the last few decades, erosion the Te Rauone scheme seeks to remedy. Dr Brian Stewart also found that cockle density was over north Te Rauone beach, and advised us that "*The southern end of the beach is more sheltered with less sand*

³⁰Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

³¹ NIWA client report (2004). Feasibility study to investigate the replenishment/reinstatement of seagrass beds in Whangarei Harbour - Phase 1. Prepared for Northland Regional Council. Report Number AKL2004-33.

³² Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

³³ Stewart, B. (2017). Investigations into the effects of commercial harvest of Clams (*Austrovenus stutchburyi*) in Otago Harbour (COC3), Otago: Final report on experimental harvesting 2017. Prepared for Southern Clams by Ryder Environmental.

movement. Thus, it is more conducive to cockle settlement and growth. The further north along the beach you go the less stable the sediment is, so cockles are less likely to settle and remain. This phenomenon is also apparent along Warrington Spit, with cockles becoming almost non-existent as you approach the mouth (i.e. moving from north to south along the spit).” (Dr B. Stewart, pers. comm. 2020).

Our sampling results matched well with our *a priori* prediction of occurrence and density of cockles based on sediment; stability and recruitment. With this in mind, it was not unexpected that cockles were not detected by our sampling within the scheme footprint but were instead found south of the footprint nearer to the existing *Zostera* (seagrass) beds where sediment is more stable and more suitable in terms of make-up, i.e. over the control transects (Table 2).

Table 2: Overall percentage occurrence of cockles in benthic samples (n=3 samples for each tidal height of each transect).

| Transect Location | Impact | Control (n=9 in each case) |
|-------------------|--------|----------------------------|
| Low Tide | nil | 33.3 % |
| Mid Tide | nil | 44.4 % |
| High Tide | nil | 22.2 % |

Infauna communities

A total of 6,813 infauna animals, among 66 taxa, were found within the benthic samples (Appendices 2 & 3). From the results in this assessment, in conjunction with previous published reports³⁴, there is no indication that uncommon or rare species occur within the scheme footprint area. Samples collected within the scheme footprint contained fewer organisms (individual animals) than the nearby control area, for all sections (high, mid and low tide) (Figure 7 and Appendices 2 & 3). The species richness of taxa across samples, however, was similar between control and scheme footprint areas within each tidal-section (Figure 8).

The relative abundances and species richness of benthic fauna, as reported here for both the scheme footprint and control area, are similar to the range of abundances and richness reported elsewhere for samples taken from the area in 2010.³

³⁴ Paavo B. 2010. Te Rauone Sampling – Results Reporting, amended memo supplied by POL.

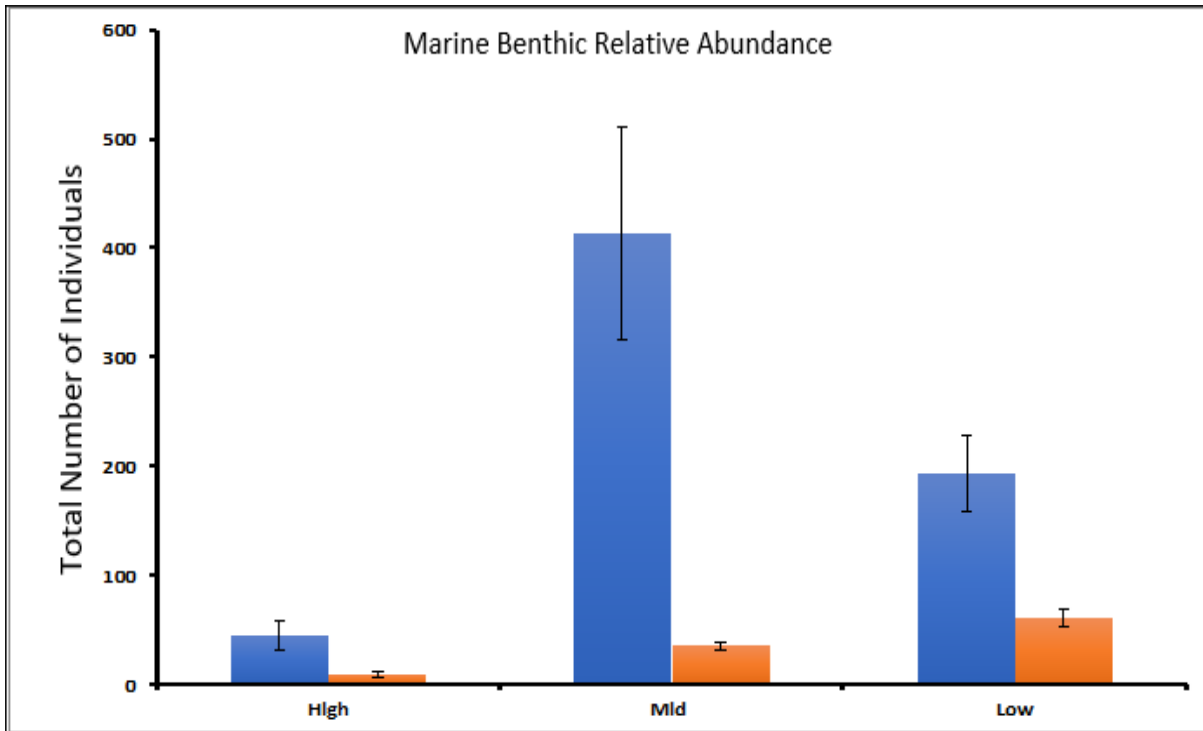


Figure 7: Relative abundance of benthic fauna (average number of individuals across samples, ± 1 standard error of the mean) found over the scheme footprint (orange bars) and control site (blue bars) over three different tidal heights (high, mid and low tide). N (number of samples) in all cases = 3.

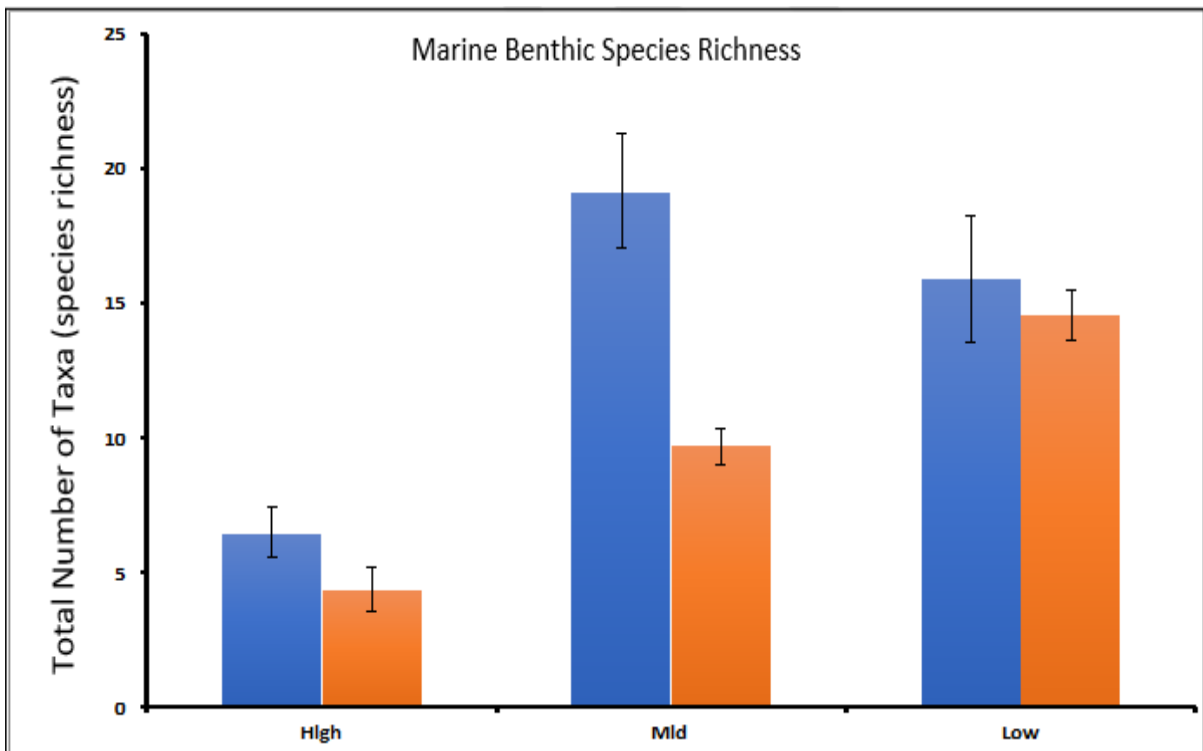


Figure 8: Average number of taxa (species richness), across samples (± 1 standard error of the mean), over the scheme footprint (orange bars) and control site (blue bars) over three different tidal heights (high, mid and low tide). N (number of samples) in all cases = 3.

Marine Benthic Spatial Variability

Spatial variability is important and this variability is captured in the error estimates of our collated data for relative abundance and species richness (Figures 7 & 8). The highest variability was found between samples collected in the mid-tide region where total number of individual animals found within our samples varied from c. 300-500 individuals (see error bars in Figures 7 & 8). For all other sampling, variation was much less apparent.

We also carried out simple ordinations of species richness and relative abundance (termed “spatial variability” here) within each sample, in two-dimensional ordination space; as noted above, samples that are similar in terms of number of both species richness and species relative abundance will cluster close together in the ordination figures (Figures 9 & 10). Treatment samples showed a greater range of complexity compared to control sampled that were represented entirely, in terms of complexity, within the treatment samples (Figure 9).

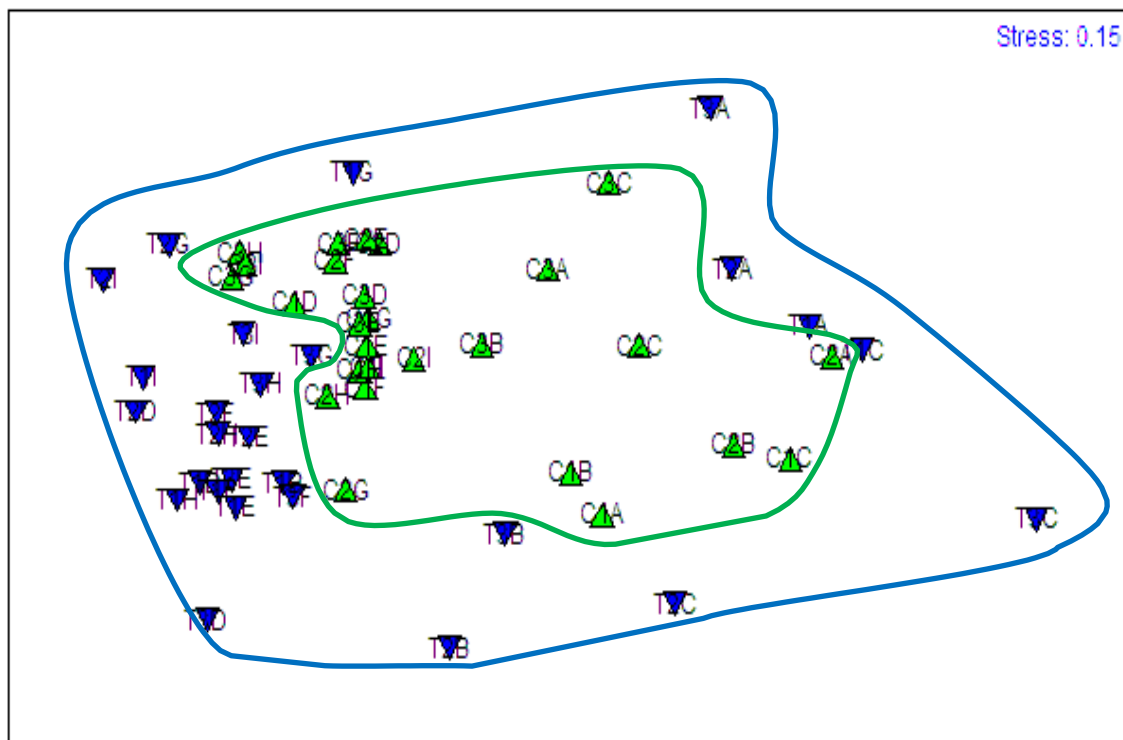


Figure 9: Infauna community structure ordination from Te Rauone Beach showing intra-sample species richness over control samples. Green triangles (with green polygon) are samples taken at the three tide heights along the transects in the control area (south end of Te Rauone Beach), and blue triangles (surrounded in the blue polygon) are samples taken at the three tide heights along the transects within the scheme footprint. Codes are obscured in this Figure, but each triangle represents an individual sample that spans all three tidal heights (N=54 samples, 27 each for impact and control).

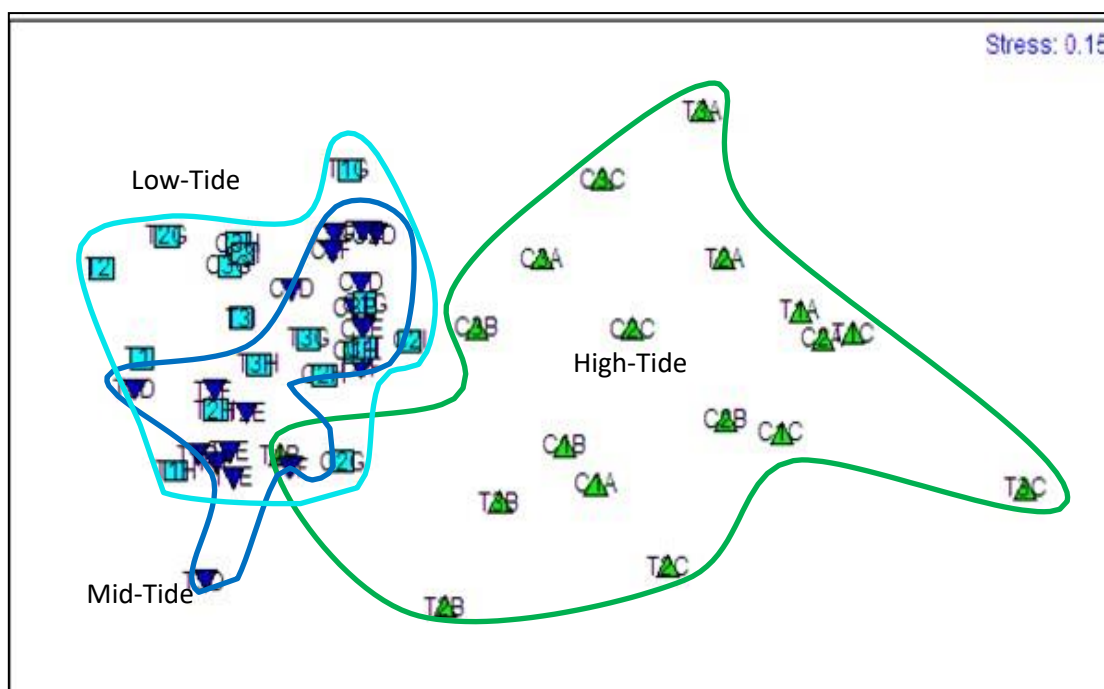


Figure 10: Infauna community structure ordination from Te Rauone Beach. Green triangles (surrounded in green polygon) are samples taken at high tide height along the transects, Blue triangles (surrounded in blue polygon) are samples taken at mid tide height along the transects, Cyan squares (with cyan, or light blue polygon) are samples taken at low tide height along the transects. Codes are obscured in this Figure, but each triangle represents an individual sample that spans all three tidal heights (N=18 samples for each tidal height).

When samples over high, low and mid tide were considered separately (i.e. irrespective of whether or not they were collected at the control or impact site, high tide samples (with 1 exception) were more similar to each other, in terms of complexity, than they were to all low and mid tide samples (Figure 10). All low and mid tides samples were very similar to each other (Figure 10).

Similarity Analyses

An analysis of similarity was also performed on the same data used in the ordinations, based on a ranked dissimilarity matrix (Table 3 & 4). The results of the analysis of similarity supports the visual representation of infauna presented in the ordinations. When looking at the similarity within the control area regardless of tide height there was only 49.02 % similarity, indicating that some similarity of the number or species present and the abundance of animals is occurring within the control samples, but samples were not identical (also see

Figure 9). A similar value was found for the treatment group (40.65 %) and for the comparisons between the control and impact areas (42.40 %) (Table 3).

Table 3: Similarity indices of marine benthic samples between impact and control samples pooled across all tidal heights; n=27 samples in all cases.

| Transect Location | Impact | Control |
|-------------------|---------|---------|
| Impact | 40.65 % | |
| Control | 42.40 % | 49.02 % |

When comparing the tidal height, the highest similarity of infauna communities occurred within the low tide height (60.07 % similarity) with the lowest occurring between high and mid tide height (22.94 %), and a very low similarity occurring between high and low tidal heights (28.44 %) (Table 4 and Figure 10). There was little difference between the mid and low communities (58.33 %) and this result is likely to be because of the low sloping intertidal environment sampled.

Table 4: Similarity indices of marine benthic samples between tidal height samples pooled across all treatment and control sites; n=18 samples in all cases.

| Transect Location | High | Mid | Low |
|-------------------|---------|---------|---------|
| High | 40.67 % | | |
| Mid | 22.94 % | 58.33 % | |
| Low | 28.44 % | 59.05 % | 60.07 % |

Botanical Values

DCC Te Rauone Domain

As noted above in Section 6, DCC had commissioned a botanical assessment of the Te Rauone Recreation Reserve over late 2018³⁵ that was provided to us prior to the terrestrial survey taking place. Following a significance assessment of the vegetation and fauna habitats of the Te Rauone Reserve against criteria in the 1st Generation DCC District Plan, the report concludes that:

“Overall Assessment - Site is significant in terms of District Plan Criteria. Te Rauone Reserve contains indigenous vegetation on Acutely Threatened land environments with <10% indigenous cover left at a national scale. Sand dunes are a historically rare ecosystem type classified as Endangered. The site provides habitat for a good-sized population of southern grass skink”.

³⁵Ecological Assessment of Te Rauone Reserve, Otago Peninsula, Contract Report produced for Parks and Recreation Department, DCC, September 2018. 24 p.

During our October 2019 and March 2020 terrestrial ecology surveys, only two vegetation communities, and mature trees, were found to occur within the scheme footprint. Small areas (less than 10 m² in total) of pohuehue vineland will be affected, and even smaller areas of indigenous plantings³⁶ (see Figure 10). The pohuehue vineland to be affected by works is regarded as significant habitat under the DCC 2GP Policy 2.2.3.2, due to the presence of southern grass skinks and their habitat triggering the “rarity” criterion; not because of the vegetation in its own right (Appendix 4b). The indigenous plantings are also significant, in places over the Reserve where southern grass skinks were detected (see Figure 13), but these areas will not be affected by the scheme (Figure 10).

Site Establishment Area/ Storage/Access

Apart from providing a small amount of habitat for southern grass skink along the very edge of the pohuehue vineland (see below), the 0.17 ha area contained no other significant ecological values (location shown in Figure 10). This seaward fence has been partially destroyed by coastal erosion, and part of this fence is hidden beneath a tangle of pohuehue, bracken fern and blackberry that forms a thicket on and against the fence. The thicket is most dense on the seaward side of the fence, with only small patches of it encroaching onto the survey area. The northern edge of the property was not fenced and the site has been recently used as a dumping ground for garden waste (Figure 11).

The site is best described as a wasteland site, dominated by exotic grasses and herbs (Appendix 5). The vegetation was dominated by exotic grasses such as cocksfoot, brown top, sweet vernal with some Yorkshire fog (see Appendix 5 for a plant species list). Exotic herbs common over sandy soils of the Otago Peninsula, such as sheep sorrel, dove's-foot crane's-bill, chickweed (along roadside) and cat's ear were common. Towards the northwest corner, some gorse and broom were present; and yellow lupin was common in places. Indigenous plants were rare; pohuehue and bracken fern formed part of the tangled thicket edge on and adjacent to the seaward fence, and occasional *Juncus* species also occurred there. No plant species listed on the Dunedin City Council 2GP Appendices 10A.1 or 10A.3 occurred over the site establishment/storage area; and no vegetation meeting the Dunedin City Council 2GP definition of “indigenous vegetation” occurred there. The vegetation of the site failed to trigger significance under the DCC 2GP criteria in its own right (see assessment in Appendix 4b); but the presence of southern grass skink habitat makes the small area of pohuehue vineland where a single southern grass skink was sighted significant under the criteria (Appendix 4b and Figure 10).

³⁶Plantings over the reserve included ngaio (*Myoporum laetum*), cabbage tree (*Cordyline australis*), flax (*Phormium tenax*), manuka (*Leptospermum scoparium*), broadleaf (*Griselinia littoralis*), *Coprosma propinqua*, korokio (*Corokia cotoneaster*), shore hebe (*Hebe elliptica*), *Hebe* species, toetoe (*Austroderia richardii*) and *Olearia* spp. No kowhai (*Sophora microphylla*) were observed, but this species was recorded from the reserve in the DCC contract report.



Figure 10: Site plan of scheme footprint showing the vegetation communities over and directly adjacent to affected areas: pohuehue vineland (red polygons) and indigenous plantings of indigenous plants (various indigenous plants but not pikao, or mature kowhai) (yellow polygons). Blue circles show indicative locations of mature exotic trees that may have branches overhanging the access tracks that could require some trimming to allow clear passage of construction vehicles. Orange=pikao plantings that are completely avoided by works. Purple= beach with sparse cover of blackberry and residual pohuehue vineland, now almost entirely eroded away by the sea.



Figure 11: View across the proposed site establishment/storage area looking north to a small shed that lies just outside the site. Dumped garden rubbish is visible in the middle of the photograph, and the edge of the pohuehue/blackberry thicket that covers the seaward fence in part, is visible on the left of the photograph.

Sea Mammals

Sandy beaches favoured by the nationally vulnerable³⁷ Hooker's sea lion (sea lion) are a limited resource in the Otago Harbour, and the wider Te Rauone Beach is an important sea lion haul-out location (Jim Fyffe, DOC, pers. comm. October 2019). Sea lions haul up to rest, birth, suckle their young, play and socialise; they require rest and during hot weather flick sand onto themselves to cool off. Sightings are, however, generally confined to the southern part of the beach that lies outside the scheme footprint. In part, the preference for the southern part of Te Rauone is likely to be due to the steep-sided banks, formed by the severe erosion at the northern end; these areas are difficult for sea lions to traverse to access the back dunes. Sea lions can move up to 1 km inland in search of a quiet sandy resting place. The lack of sandy beach habitat at the northern end also contributes to the low incidence of sea lions over the northern reaches.

Although no sea lions were observed over the scheme footprint during the field-assessment, the scheme is likely to create habitat for sea lions (see Section 8 below), and the southern Te Rauone beach is known to have been regularly frequented by mothers, pups and bulls, since

³⁷Baker *et al.* 2019. Conservation status of New Zealand marine mammals, 2019. NEW ZEALAND THREAT CLASSIFICATION SERIES 29. Department of Conservation.

breeding recommenced in the Otago Harbour after c. 150-200 years (e.g. Figure 12). Furthermore, a Te Rauone local showed us a 2016 photograph of an adult sea lion hauled up on the beach over the northern reaches; and two sea lions were observed within the DCC Reserve during a recent ecological survey (2018³⁸), confirming that they do indeed use the northern beach on occasion (i.e. the scheme footprint).



Figure 12: A known sea lion called Lorelie, and her pup, photographed over the 2017/2018 season on the southern part of Te Rauone beach. Photo from Stuff.co.nz

Birds

Four indigenous bird species were recorded during the field-assessments and the native welcome swallow was also recorded (Table 5). Red billed gulls were sighted both on the water near to the beach, and resting on the rock wall at the northern tip of Te Rauone Reserve; in addition, several red billed gulls flew over the site during the assessment. A little shag (*Phalacrocorax melanoleucos*) also flew over the water, near to the beach, during the October field assessment. No breeding habitat, nor habitat vital for the persistence of either red billed gulls or little shags was detected during the field-assessments of the scheme footprint.

Within the Te Rauone DCC Reserve/Domain, a tui (*Prosthemadera novaeseelandiae*) was observed flying over during the March 2020 survey; and a grey warbler (*Gerygone igata*) was heard in the distance that may have been within the reserve. The DCC commissioned ecology report³⁸ also noted very few indigenous bird species within the reserve and beach area, but did note Eurasian blackbird (*Turdus merula*), chaffinch (*Fringilla coelebs*), white-faced heron

³⁸ Ecological Assessment of Te Rauone Reserve, Otago Peninsula, Contract Report produced for Parks and Recreation Department, DCC, September 2018. 24 p.

(*Egretta novaehollandiae*), and grey warbler, with red billed gulls flying over the reserve and swimming offshore during that field-assessment.

The stumps of very large trees that littered the beach at the northern end of Te Rauone Recreation Reserve had bird droppings indicating they are used as resting areas for local sea-birds, most probably red billed gulls, but possibly white-fronted terns, or a shag species. A lone *Eucalyptus* spp. tree near to the beach was not being used as a roost site (at least at the time of the assessments). Shags, in particular, roost year-round in some trees (and on boats) of the inner harbour. During the survey, should birds have been using trees adjacent to the footprint as roosts, they would have been very obvious. The 6 gum trees along the southern boundary of the 0.17 ha proposed site establishment/storage area were also examined as potential bird-roosting sites; no evidence was found that these trees had been used as roosting habitat. Many other indigenous bird species are also known to frequent Te Rauone beach, especially the tidal flats over the southern part of Te Rauone Beach; these are included in Table 1 to provide a list of bird species that could benefit from the scheme. In addition to the indigenous species sighted, a number of exotic birds were recorded in and around the vegetation of the foredunes of the scheme footprint (Table 5).

Lizards

The southern grass skink (*Oligosoma* aff. *polychroma* clade 5) was detected at multiple sites along the foredunes of the scheme footprint (landward berm of the beach); at one site within the proposed site establishment/storage area (near the seaward fence line on the edge of the pohuehue/blackberry thicket), and this species is also known to occur over the Te Rauone Reserve/Domain (Figure 13). This species is currently listed by DOC as nationally at-risk declining³⁹, and the habitat of this species is significant under the Otago RPS and DCC 2GP Policy 2.2.3.2 (see next Section). Southern grass skinks (Figure 14) are also listed in Appendix 10A.2 of the Dunedin City Council 2GP.

Invertebrates

During the walk-through survey of the proposed site establishment/storage area, indigenous short-horned grasshoppers (probably *Phaulacridium marginale*) were very common; and under discarded fence posts, the indigenous seashore earwig (*Anisolabis littorea*) was also present. Neither of these species are ranked at risk or threatened by the Department of Conservation and neither are listed in the Dunedin City Council Appendix 10A.2. The DCC commissioned ecology report reviews species commonly encountered in habitat provided within the Te Rauone Reserve, although none of the species described were encountered during that or our assessments.

³⁹ Hitchmough *et al.* 2015. Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. Department of Conservation.

Table 5: Bird species sighted and known to frequent Te Rauone Beach. *denotes exotic bird species. Threat Classifications as per Robertson *et al.* 2016. Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. DOC, Wellington.

| Common Name | Scientific Name | Sighting Type | Source | Threat Classification |
|----------------------------|--|---------------|---|----------------------------|
| Red Billed Gull | <i>Larus novaehollandiae</i> | present | Field assessment | At Risk Declining |
| Little Shag | <i>Phalacrocorax melanoleucos</i> | present | Field assessment | Not threatened |
| Southern black-backed gull | <i>Larus dominicanus</i> | present | DCC Coastal Dune Reserves Management Plan | Not threatened |
| Tui | <i>Phalacrocorax melanoleucos</i> | fly over | Field assessment | Not threatened |
| Grey warbler | <i>Gerygone igata</i> | heard | Field assessment | Not threatened |
| Welcome swallow | <i>Hirundo neoxena</i> | present | Field assessment | Not Threatened |
| Variable Oyster Catcher | <i>Haematopus unicolor</i> | present | iNaturalist NZ | Recovering |
| Pied Stilt | <i>Himantopus himantopus</i> | present | iNaturalist NZ | Not threatened |
| White-faced heron | <i>Egretta novaehollandiae</i> | present | iNaturalist NZ | Not threatened |
| White-fronted Tern | <i>Sterna striata</i> | fly over | iNaturalist NZ | At Risk Declining |
| Southern blue penguin | <i>Eudyptula minor minor</i> | occasional | DOC | At Risk Declining |
| Yellow eyed penguin | <i>Megadyptes antipodes</i> | occasional | DOC | Nationally Endangered |
| Little Pied Cormorant | <i>Phalacrocorax melanoleucos melanoleucos</i> | present | iNaturalist NZ | Vagrant |
| Little Owl* | <i>Athene noctua</i> | present | iNaturalist NZ | Introduced and Naturalised |
| Chaffinch | <i>Fringilla coelebs</i> | present | DCC Ecological Report | Introduced and Naturalised |
| Eurasian blackbird* | <i>Turdus merula</i> | present | Field assessment | Introduced and Naturalised |
| House sparrow* | <i>Passer domesticus</i> | present | Field assessment | Introduced and Naturalised |
| Common starling* | <i>Sturnus vulgaris</i> | present | Field assessment | Introduced and Naturalised |
| Dunnock* | <i>Prunella modularis</i> | present | Field assessment | Introduced and Naturalised |
| Mallard* | <i>Anas platyrhynchos</i> | fly over | Field assessment | Introduced and Naturalised |
| Song thrush* | <i>Turdus philomelos</i> | present | Field assessment | Introduced and Naturalised |



Figure 13: Location of southern grass skinks found October 2019; March 2020 and during the DCC commissioned ecological survey. Red dots show areas with good numbers of skinks (≥ 5 animals sighted and/or captured during the survey) and yellow dots show < 5 individuals located/sighted.



Figure 14: southern grass skink (*Oligosoma* aff. *polychroma* clade 5) found along the landward berm of the beach.; over the Te Rauone Domain, and on private land proposed for use as site establishment/storage.

Significance Assessment of Habitat

Otago RPS Criteria

Schedule 4 – ‘Criteria for determining significant indigenous vegetation and significant habitat of indigenous biodiversity’ of the Proposed Otago Regional Policy Statement (2017; Appeals Version), contains criteria to test for RMA Section 6c significance. The scheme footprint pohuehue vineland vegetation is significant, in places, as it triggers Criterion 2, Rarity, by providing habitat for the southern grass skink, an at-risk lizard species.

DCC 2GP Significance Criteria

Policy 2.2.3.2 of the DCC 2GP contains Section 6c significance criteria (provided here in Appendix 4a). The pohuehue vineland vegetation is significant, in places, as it triggers Criterion b, Rarity, by providing habitat for the southern grass skink, an at-risk lizard species.

DOC guidelines for assessing significant ecological values⁴⁰

The pohuehue vineland vegetation is significant, in places, as it triggers the DOC ‘Rarity and special features’ criterion by containing habitat for the at-risk declining southern grass skink.

⁴⁰ M. Davis, N.J. Head, S.C. Myers and S.H. Moore 2016. Department of Conservation guidelines for assessing significant ecological values. Published by Publishing Team, Department of Conservation, PO Box 10420, The Terrace, Wellington 6143, New Zealand.

8. Actual and Potential Effects on Ecological Values

For all Te Rauone ecological values subject to this EA, the following assessment of effects assumes no management of effects will be carried out (but see Sections 9-11).

Marine Benthic Communities

Overview of Effects Assessment & Anticipated Effects

In forming our view on the likely effects of the scheme on the marine benthic fauna, we made the following assumptions:

- The scheme could have 3 overarching effects on the benthic environment. In decreasing order of potential significance, these are: loss of habitat through the deposition of rock groynes onto the seabed; vehicle traffic over seabed; and transient increases in turbidity when sediment is deposited (and “topped up”) onto the beach. A fourth effect, the potential biosecurity threat introduced with the rock, as groynes are constructed, is considered of low significance.
- In forming our view on the order of significance of potential effects, and the relative ‘down-playing’ of increased turbidity effects following sediment deposition, we refer to our experience and first-hand knowledge of the massive fluctuations in sediment loading (especially fine sediment) and turbidity, known to occur within the Otago Harbour, naturally⁴¹. With this information we formed the view that any temporary increases in siltation/turbidity associated with the sediment leaving the beach from sediment pumped there, will be within ‘normal’ limits for the Otago Harbour.
- There is a large body of information supporting the view that the marine benthic environment of the Otago Harbour is highly resilient to disturbance, and high turbidity (silt loading) is commonplace in the Otago Harbour following heavy rain over the surrounding hills. POL need to regularly dredge the shipping channel to remove sediment that is continually deposited there, clear evidence of a naturally dynamic system, in terms of sediment flow and movement (also see NIWA client report 2009⁴²).
- We assumed the most significant effect of the scheme’s construction, on marine benthic communities, would be the deposition of the rock groynes over the existing seabed, an effect difficult to quantify given post-scheme sampling would not be possible beneath the rocks. These assumptions were the primary driver for the selection of our control and impact sites outside of the groyne area, as detailed above.

⁴¹ Dr B. Stewart pers. comm. October 2019. Dr Stewart has had decades of experience working in and around the Otago Harbour and he provided oversight of the likely effects (both positive and negative), the marine benthic surveying and sampling and the data analyses and interpretation; all of which is detailed in this EA.

⁴² NIWA Client Report: Port of Otago Dredging Project: Harbour and Offshore Modelling HAM2008-179, February 2009-revised June 2009.

- Except for seagrass beds, that are located in areas of the harbour that are relatively stable in terms of sediment disturbance through wave action, or sediment deposition/removal with tides and rainfall over the wider area; the marine benthic environment is homogenous over large areas of the Otago Harbour. This fact was borne out by our sampling where control and impact sites, although differing in location relative to the harbour mouth where tidal disturbance is considered greatest, had similar species composition and relative abundance of infauna across each tidal height.
- Substantive changes to sediment quality/size are unlikely to occur over the footprint given re-nourishment material is coming from the dredged channel of the harbour. Instead, we expect a redistribution of sediment with the area seaward of groynes experiencing the deposition/accretion of finer sediment, and maybe organic matter (muddy sediment). Our sampling has anticipated this effect.
- Deep sub tidal sediment from the dredged channel, will not influence the recovery of the intertidal marine benthic communities' present at Te Rauone.

Anticipated Positive Effect

Increase in Marine Benthic Communities, Post-Scheme

The implantation of rock groynes will help stabilise new sediment deposited through the re-nourishment efforts. We expect that deposition of sediment will differ for each side of a groyne, with concomitant variation in abundance and species richness of benthic epifauna (and flora, such as seagrass). It is likely that infauna invertebrate communities will also increase in relative abundance as sediment becomes more stable and the community becomes established with fewer disturbances; this includes locally important species such as the New Zealand cockle (see also below).

The claim that there will be an increase in infauna invertebrate communities, post-scheme, can be substantiated by a mix of scientific literature from elsewhere in the world on coastal rock structures (e.g. Walker et al. 2008); and from research into the effects of harbour dredging on the marine benthic environment. Dredging studies have demonstrated that despite the physically and biologically dynamic environment affected by dredging, benthic communities are persistent and exhibit both resistance and resilience to physical disturbance, and also display major recruitment events following dredging. Walker et al. 2008, as an example, found increases in abundance and biodiversity of benthic fauna on one side of a coastal (not harbour) rock groyne structure. For dredging studies outside of New Zealand, marine benthic communities were found to re-establish within relatively short time frames of

30 days to 2 years (Brosnan 1999⁴³, Irwin 1999⁴⁴), and advice received from Dr Brian Stewart, and results from local studies, have indicated that the benthic organisms in deep channel Otago Harbour sites will recolonise at rates similar to those observed following dredging elsewhere (e.g. Ralph and Yaldwin 1956⁴⁵, Grove 1995⁴⁶, Paavo *et al.* 2008⁴⁷). Furthermore, a moderately diverse benthic community was recorded at a site in the Otago Harbour only 2- 3 weeks after dredging (Dr B. Stewart, pers. comm. 2020).

With these studies in mind, we predict complete recovery in the benthic environment, post-scheme, will likely occur within 1-2 years. This estimate is broadly consistent with Paavo (2010⁴⁸) who although making his assessment of a seawall, not 3 perpendicular rock groynes, shares our confidence in the resilience of the marine environment of the harbour. Moreover, when Paavo (2010) is read as a whole, and in the context of his earlier work in the harbour (e.g. Paavo *et al.* 2008⁴⁷), and our own research and experience (e.g. Stewart 2013⁴⁹, Stewart 2018⁵⁰); our estimate of one or two years is entirely reasonable. For example, the dredging research demonstrates recovery within 30 days to 2 years, and this result is borne out by Paavo's earlier work (Paavo *et al.* 2008). What is clear, is that benthic communities are dynamic and resilient and as pointed out above, and by Paavo (2010), the effects of new structures in inner harbour areas are very site-specific (e.g. see the review in Airoidi *et al.* 2005⁵¹).

Actual & Potential Adverse Effects

Loss of Marine Benthic Habitat and Death of Localised Infauna and Epifauna

The area where the groynes will be established will be lost, but due to the homogenous nature of the beach, the loss of this area is not considered a highly significant effect. This assessment is supported by the results of the benthic sampling reported on above. As noted above in Section 4, Dr Stewart believes that some elements of the macroinvertebrate communities may even be able to migrate out of this area as rock substrate is placed upon the shore

⁴³Brosnan, B.C. (1999). Recovery of terrestrial and marine communities in a New Zealand fiord after large-scale disturbances. Unpublished MSc thesis, University of Otago.

⁴⁴Irwin, C.R. (1999). The effects of harvesting on the reproductive and population biology of the New Zealand Littleneck Clam (*Austrovenus stutchburyi*) in Waitati Inlet. Unpublished MSc thesis, University of Otago.

⁴⁵Ralph, P.M and Yaldwin (1956). Seafloor animals from the region of Portobello Marine Biological Station, Otago Harbour. *Tuatara* 6(2): 57-85.

⁴⁶Grove, S.L. (1995). Subtidal soft-bottom macrofauna at the upper Otago Harbour. Unpublished MSc thesis, University of Otago.

⁴⁷Paavo, P.L., Probert, P.K., James, M.R. (2008). Benthic habitat structures and macrofauna of lower Otago harbour. Report to Port Otago Ltd.

⁴⁸Paavo B. 2010. Te Rauone Sampling – Results Reporting, amended memo supplied by POL.

⁴⁹Stewart, B. (2013). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

⁵⁰Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

⁵¹Airoidi, L., M. Abbiati, M. W. Beck, S. J. Hawkins, P. R. Jonsson, D. Martin, P. S. Moschella, A. Sundelöf, R. C. Thompson, and P. Åberg. 2005. 'An Ecological Perspective on the Deployment and Design of Low-Crested and Other Hard Coastal Defence Structures'. *Coastal Engineering* 52(10):1073–87.

meaning a total loss scenario may not occur. We consider this potential effect to be no more than minor.

Effects of Physical Disturbance by Vehicles

The proposed works to install the rock groynes will result in loss and/or disturbance of the seabed and resident benthic communities, as the machinery moves backwards and forwards over the bed to retrieve rocks from the stockpile and place the rocks on the groynes. This short-term, temporary effect is not considered significant, and again, this assessment is supported by the benthic sampling reported on above. In addition, previous researchers have suggested that any infauna communities lost and/or disturbed over the duration of the POL works to build groynes at Te Rauone will recolonise the scheme footprint area over a period of one or two years⁵². We concur with this assessment. We consider this potential effect to be no more than minor.

Increases in Local Turbidity

As the sediment proposed to re-nourish Te Rauone beach will include a range of size classes of substrate (i.e., fine to coarse), but a range entirely within the natural range for Otago Harbour, it will be possible for the fine sediment to become suspended in the immediate vicinity of the beach. As noted above in Section 4, the harbour normally experiences heavy sediment loading during flood and heavy rainfall events, and as such, it follows that the benthic communities are adapted to naturally turbid conditions. Due to the strong currents in the area and a relatively fast cycling of water in the harbour, it is likely that this will be no more than a short term, minor effect. We consider this potential effect to be no more than minor.

Rock Groynes as a Biosecurity Issue

Given the existing Otago Harbour environment is far from pristine, the rock groynes proposed for Te Rauone will not contribute significantly to the risk of marine species incursions into the harbour. In terms of future incursions of marine species, we note the existing Aramoana mole, as well as the multiple wharfs inside the harbour, already provide substrate for marine plants and animals. The rock for the groynes will be sourced from an inland quarry, and will be clean from possible marine pathogens at the time they are installed i.e. there is no chance of marine species being introduced to the environment at Te Rauone through the quarried rock. We consider this potential effect to be no more than minor.

Overall, we anticipate the effects of the scheme on marine benthic communities of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together.

⁵² Paavo B. 2010. Te Rauone Sampling – Results Reporting, amended memo.

Cockle Beds

Anticipated Positive Effect

Establishment of New Cockle Beds

The replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of cockles. Our assessment of “likely” includes with it a level of uncertainty, and as such we add a caveat that replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of cockles, *should the scheme successfully lessen erosion over the northern reaches of Te Rauone Beach.*

Actual and Potential Adverse Effects

Increases in Local Turbidity

Potential increases turbidity when sediment is deposited may adversely impact on local cockle beds. This effect is considered to be of very low significance, because cockles are known to be resilient to sediment, including complete burial at times (Hewitt & Norkko 2007)⁵³. We consider this potential effect to be no more than minor.

Cockles and Other Shellfish Communities- Effects of Physical Disturbance

Although significant cockle beds, or indeed any cockles at all, were not detected within the footprint we acknowledge, however, that sampling is not the same as a population census, and cockles are almost certain to be present within the footprint either as spat, or juveniles/subadults/adults (albeit at low densities). Moreover, we expect losses will occur in any cockle habitat that currently lies beneath the area where the rock groynes will be placed. Previous surveys have estimated biomass of the cockle in vicinity of Te Rauone ranges from 0.45 ± 1.00 kg/m² in 2013, to 0.81 ± 0.72 kg/m² (in 2018)⁵⁴. We accept that there will be losses where groynes are installed, but note that natural recruitment of the cockle in the area has been recorded⁵⁵.

In terms of physical disturbance (other than placement of rocks), there is a large body of literature that investigates the effects of mechanical harvesting on cockles and non-target species; but very few that discuss the actual impacts of the vehicles themselves, and subsequent sediment compaction on cockles. We know from work carried out by Dr Stewart

⁵³ Hewitt, J.E. and Norkko, J. (2007). Incorporating temporal variability of stressors into studies: An example using suspension-feeding bivalves and elevated suspended sediment concentrations. *Journal of Experimental Marine Biology and Ecology* 341: 131-141.

⁵⁴ Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

⁵⁵ Stewart, B. (2018). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental. reference

at Warrington that how much effect vehicular traffic has on cockle beds depends very much on density of cockle and density of traffic. The upper beach area at Warrington has been subject to very high rates of vehicle movement for many, many years, and while cockle density is low, cockles still exist there⁵⁶. This study provides some reassurance that any cockles within the footprint at Te Rauone will not suffer complete loss following the vehicle movements to place the rocks. The difference at Te Rauone, however, is the degree of overlap between the cockles and traffic. At Warrington, vehicles tend to use the upper tide levels of a beach (firm sediment) while cockles tend to be much lower down (mid to low tide). Consequently, damage is likely to be slight. At Te Rauone, however, vehicle traffic to place rocks onto the groyne will cover high, mid and low tide zones, and thus being more likely to overlap with any cockle's present.

The effects of this vehicle movement on cockles at Te Rauone will be at least partially mitigated by the robust nature of cockles, being often referred to as "bioturbators"⁵⁷. Cockles are highly mobile and capable excavators, able to resurface within days (often hours) from under 2, 5 and 10 cm, and even 25 cm, of sediment, where no physical disturbance to their natural (*in situ*) orientation had occurred (NIWA 2017)⁵⁸. Cockles repeatedly re-surfaced following daily reburial, for up to 30-days, indicating they were resilient to at least low levels of repeated burial/disturbance. There may, however be some losses/deaths of the low-density cockle beds of the schemes footprint as a result of vehicle traffic.

Overall, we anticipate the effects of the scheme on cockles of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together.

Seagrass Beds

Anticipated Positive Effect

Establishment of New Seagrass Beds

The replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of dense (as opposed to the sparse beds present now) native *Zostera marina* (eelgrass/seagrass) beds. Seagrass beds are recognised as being ecologically important in providing nursery grounds for a wide variety of intertidal invertebrates and fish, and as feeding areas for birds and fish, and once established, the roots help to stabilise sediments and improve water clarity. As noted above for cockles, our assessment of "likely" includes with it a level of uncertainty, and as such we

⁵⁶ Stewart, B. (2013). Baseline Environmental Monitoring for Project Next Generation: In-harbour assessment. Ryder Environmental.

⁵⁷ Li, B., Cozzoli, F., Soissons, L. M., Bouma, T. J., & Chen, L. (2017). Effects of bioturbation on the erodibility of cohesive versus non-cohesive sediments along a current-velocity gradient: A case study on cockles. *Journal of experimental marine biology and ecology*, 496, 84-90.

⁵⁸ NIWA client report (2017). Effect of sand deposition on the New Zealand cockle, *Austrovenus stutchburyi*. Prepared for Marlborough District Council, Report number 2017214NE.

add a caveat that replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats that are likely to be suitable for the establishment of native *Zostera marina* (eelgrass/seagrass) beds, *should the scheme successfully lessen erosion over the northern reaches of Te Rauone Beach.*

Actual and Potential Adverse Effect

Increases in Local Turbidity

Due to the cyclical nature of the tides in the outer harbour, coupled with the location of the scheme footprint near to the harbour entrance and our joint experience, we hold the firm view that fine sediment, that most threatening to seagrass condition and growth, will not be retained in the area for longer than known tolerance levels (see Section 4). More importantly, we do not believe fine sediment that is retained following re-nourishment (including top-ups) will drift up the harbour to reach lethal levels over the existing seagrass beds over the southern reaches of Te Rauone Beach, and as we understand it, it is unlikely that the intermittent “top ups” will be of a scale comparable to the initial works and as such, the effects will be less than those of the first renourishment attempt.

Given suspended sediment does pose a threat to the southern seagrass beds of southern Te Rauone beach, and given they are slow to re-establish if damaged⁵⁹, management actions should be considered, actions only triggered should monitoring show *Zostera* (seagrass) beds have become irreparably damaged by sediment generated by the scheme (see Section 10). As noted above, POL have existing data showing the extent and health of the *Zostera* beds of Te Rauone that creates an excellent baseline data set.

Overall, we anticipate the effects of the scheme on seagrass beds of the scheme footprint, and beyond, will be no more than minor when the mix of positive and adverse effects are considered together.

Indigenous Vegetation

Actual & Potential Adverse Effects

Indigenous Vegetation Removal

The removal of small areas of indigenous vegetation, namely pohuehue vineyard, to construct access tracks will reduce the amount of indigenous vegetation over the Te Rauone Reserve/Domain. This effect as it relates to the vegetation itself, is considered less than minor, but the effect on potential habitat of the southern grass skink is considered more than minor (see “Lizards” below).

⁵⁹ Reed, B. J., & Hovel, K. A. (2006). Seagrass habitat disturbance: how loss and fragmentation of eelgrass *Zostera marina* influences epifaunal abundance and diversity. *Marine Ecology Progress Series*, 326, 133-143.

Overall, we anticipate the effects of the scheme on indigenous vegetation of the scheme footprint will be no more than minor.

Sea Mammals

As noted above, DOC sea lion expert, Jim Fyfe, was consulted on the likely effects of the Te Rauone proposal on Hooker's sea lions.

Anticipated Positive Effect

Creation of more Extensive Inner Harbour Sandy Beaches

The scheme development, by replenishing the sediment of Te Rauone Recreation Reserve, will have a potential positive effect on sea lions by providing greater expanses of sandy beach habitat they favour, a habitat that is rare in the inner Otago Harbour. In addition, by sculpturing the foredunes to visually replicate the dune system of the southern reaches of Te Rauone beach, the back dunes will again be easily accessible to sea lions.

The creation of sandy beach habitat over the northern part of Te Rauone Beach, a valuable resource for sea lions of the inner harbour, will offset entirely any potential adverse effects of the scheme on sea lions and by doing so will leave no significant residual adverse effects on sea lions. Naturally occurring sandy beaches, except for Te Rauone, are not present in the inner Otago Harbour. With this in mind, a net gain in sandy beach habitat will occur following the successful renourishment of beach at Te Rauone.

Actual & Potential Adverse Effects

Noise, Vibration and Human Presence & Temporary Displacement

Sea lions resting or socialising on the southern reaches of Te Rauone Beach, or any that occur or attempt to haul up onto the northern areas of the scheme footprint, may suffer disturbance by noise, vibration and human presence as the groynes are constructed. Disturbance may cause sea lions to be temporarily displaced from the area, during works.

Moreover, curious sealions from further afield may become "displaced" from the footprint should they firstly be attracted to it and then frightened by machinery movements, including the placement of rocks onto the seabed and groynes. Adolescent male sea lions are considered intensely curious and unmanaged attempts to move curious sea lions away from the works area can result in an increased frequency and intensity of sea lion/worker interactions, rather than a decrease; and can lead to sea lions learning undesirable behaviours that pose an ongoing risks to themselves, and people. Machinery movements, including the

placement of rocks onto the seabed and groynes, may also injure/displace any sealions moving in and around the scheme footprint.

Hooker's sea lions are generally not known to be a migratory species. Immature males, in particular, are known to have a year-round presence on beaches around the Dunedin area⁶⁰, but not on Te Rauone Beach (according to DOC sea lion expert, Jim Fyfe). Sea lions are not known to have pupped over the northern reaches of Te Rauone Beach, although mothers with young pups have been known to haul up on both the northern and the southern areas of Te Rauone beach from time to time. With this context, the most vulnerable life-stage for sea lions is during birthing and the period when pups are very young and land-based; these life-stages have never occurred on northern Te Rauone Beach, with the main breeding beaches being on Papanui Beach and Victory Beach, outside of the harbour. In support of this, the DOC website (<https://www.doc.govt.nz/nature/native-animals/marine-mammals/seals/new-zealand-sea-lion/species/biology/>) highlights this vulnerable life-stage as follows:

"Pups form pods near the periphery of harems for warmth and protection while their mothers are at sea. Pups are dependent on their mothers for milk and protection for the first year of their lives. While mothers are at sea feeding, their pups are alone. This is natural, but they are particularly vulnerable to disturbance during these periods, so keep your distance."

Heavily pregnant females that may venture inside the harbour, away from breeding beaches, and could potentially be vulnerable to disturbance through noise and vibration occurring at Te Rauone Beach. With this in mind, the period for which works on the Te Rauone scheme is avoided will include the period from mid-December-early February.

Overall, we anticipate the effects of the scheme on sea lions of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together.

Birds

Anticipated Positive Effects

Addition of Roosting and Resting Habitat

The creation of the three rock groynes (70-80 m long) will provide potential resting and roosting habitat for seabirds such as white-fronted terns, red billed gulls and occasional southern blue penguin and little shag. This habitat is a valuable addition to the inner harbour where some traditional roosting trees for these and other species have been removed recently (and not replaced) to build the Peninsula shared cycle-way.

The replenishment of sediment to the northern reaches of Te Rauone Beach will provide additional tidal flats foraging habitat for variable oyster catchers, red billed gulls, pied stilts

⁶⁰D. J. Hawke (1986) Observations of Hooker's sea lion, *Phocarctos hookeri*, at a hauling ground on Otago Peninsula, New Zealand, New Zealand Journal of Marine and Freshwater Research, 20:3, 333-337.

and southern black-backs gulls, and potentially for other birds of the Otago Harbour area, e.g. Royal Spoonbill.

Actual & Potential Adverse Effects

The Removal of 12 Stumps from the Surf and Foredunes

The removal of tree stumps from the surf and foredunes of northern Te Rauone beach will remove potential resting and roosting habitat for local birds (both indigenous species such as red billed gulls; exotic species such as greenfinch (see Table 1)). As noted in Section 5, the removal of existing tree stumps over the northern part of the scheme footprint may occur irrespective of the POL scheme because as they break away from the beach with erosion, they will pose a navigational hazard.

At the time of the ecological surveys, no birds at all were sighted on the c. 12 stumps⁶¹ located in the surf and foredunes, but the faecal sign of birds was noted and therefore stumps are included as potential indigenous bird habitat in this EA (see Figure 4). It is not clear which bird species were using the stumps, but only occasional faecal sign was observed, and given the large diversity of exotic passerines occupying the adjacent reserve, it seems likely a mix of exotic and indigenous species occasionally rest on these stumps. The stumps are not considered important habitat for indigenous birds, and the stumps represent a very small proportion of resting habitat available for all bird species of the wider site; in particular ample alternative and suitable resting habitat is available within the DCC Te Rauone reserve (Dr Sanders, pers. comm. 2020). Further to this, we have observed that during the construction of the Peninsula cycle way, indigenous bird species have been observed to be highly tolerant of construction, including the removal of roost trees. Birds have been observed in and around construction areas with no apparent changes in bird species diversity or abundance. Birds displaced from one site simply move to another; resting habitat is certainly not a limiting resource in the Otago Harbour with displaced birds resting on boat sheds, power lines and/or taking up residence in other trees. We consider this potential effect to be no more than minor.

The Removal of Branches from Mature Trees

The removal of any mature trees, or branches from them, over the Te Rauone Domain to allow access to the beach and/or site establishment/storage site may remove roosting habitat for little shags, or any other resident birds. No shags or evidence of their roosting was found, however, in and around the Domain trees during either the October or March ecological surveys. We consider this potential effect to be no more than minor.

⁶¹Some stumps were only partially intact.

Noise, Vibration and Human Presence

The noise, vibration and vehicle/human presence during construction of the scheme may disturb and/or displace resting red billed gulls; and/or deter little shags or other seabirds from venturing within the scheme footprint to forage, rest or socialise. These temporary disturbance/displacement effects are likely to be more pronounced during the outgoing tide, and low-tide, when bird foraging grounds are exposed, and when foraging usually takes place.

An assessment of bird records from the wider area led to us to take a precautionary approach to this effects assessment by assuming a variety of coastal waders may frequent the area (e.g. pied stilt, *Himantopus leucocephalus*); and the footprint maybe used occasionally by little shags (but not for roosting), southern blue penguin, yellow-eyed penguin and southern black-backed gulls. The primary effect of the scheme, however, is removing/disturbing a small area of habitat used intermittently for resting by red billed gulls (c. 3 x 3 m of rocks), a habitat that cannot be viewed as critical for this species in the harbour, where much resting habitat is available. Notwithstanding the ample availability of resting habitat for this species, in our view, any effects of the Te Rauone scheme on red billed gulls and their habitat, and on any occasional visitors to the northern part of the beach, is entirely offset by the provision of up to 210-240 m of rock groyne habitat following the completion of the scheme. Indeed, a net increase in resting (as well as wading) bird habitat is anticipated, as noted above.

The positive effects of the rock groynes for indigenous birds was discussed with Jim Fyfe, DOC, as this EA was drawn up; and the nearby Aramoana mole, a long breakwater opposite Taiaroa Head, is the obvious local example of a successful coastal rock structure that attracts a huge diversity in indigenous birds, including those mentioned in this EA and listed in Table 5, namely: white-fronted terns, red billed gulls and occasional southern blue penguin and little shag. Indeed, further to this we note that the Te Rauone scheme will provide habitat not only for species residing in and around the scheme footprint; but also, for birds removed by DCC and its contractors and not replaced to build the Peninsula cycle-way (e.g. little shag roosts within large macrocarpa trees).

Overall, we anticipate the effects of the scheme on indigenous birds of the scheme footprint will be no more than minor when the mix of positive and adverse effects are considered together. We base this assessment on the following:

- Only red billed gulls and variable oyster catcher were found within the footprint, these in low numbers (<5 individuals sighted) and only intermittent use (based on low build-up of faeces/guano on the rocks).
- Records from the wider area indicate only occasional visits by other species, and the most likely species to be a regular visitor in any numbers, apart from the red

billed gulls, is the variable oyster catcher; but available records of this species were sparse over the northern Te Rauone beach⁶².

- There was no evidence of indigenous birds roosting (little shags) or nesting (penguins) within the footprint, and no evidence of any critical habitat for any indigenous bird species present.

Lizards

Actual and Potential Adverse Effects

Temporary Loss of Habitat

The loss of small areas of pohuehue vineland to construct access tracks, and to create the site establishment/storage area will result in a reduction of habitat for the southern grass skink.

Disturbance, Death, Injury and Displacement

The grading of the landward berm of the beach with concomitant removal of habitat currently used by southern grass skinks; and the removal of small areas of pohuehue vineland over the Te Rauone DCC Reserve may result in the disturbance, death, injury and/or displacement of any southern grass skinks present over these areas at the time of works.

We consider these potential effects to be more than minor.

9. Avoidance of Adverse Effects

Plantings of pikao and pohuehue vineland

Areas of the Te Rauone Domain deemed “significant” under the DCC 2GP Policy 2.2.3.2, namely pikao plantings and areas of pohuehue vineland, are avoided almost entirely by using existing clearings and access tracks (see Figures 3 and 10). Only small areas of pohuehue vineland (estimated to be $\leq 10 \text{ m}^2$), and a very small area (c. 1.5 m^2) of indigenous plantings (not pikao) will be affected by planned construction works, and pikao plantings were avoided entirely (see Figure 10).

Lizards

Southern grass skinks are present throughout the scheme footprint, and were found in highest numbers in and around MHWS mark (Figure 13). With this in mind, ‘no-go’ zones that contain southern grass skinks or their habitat will be negotiated on-site with contractors, and marked on the ground for avoidance, prior to the commencement of works. Notwithstanding these no-go zones, and as noted above in Section 5, storage and access tracks/vehicle parking

⁶² Hand. K. 2013. Seabird Colonies of Otago: A review of current status, survey effort and implications for establishment of Important Bird Areas.

will use existing clearings and roads to further minimise the potential impact on southern grass skinks.

Lizard values require management in a formal Lizard Management Plan (LMP). Moreover, a lizard management plan will be required to be submitted to DOC for approval before lizard habitat is disturbed. A joint POL/DCC LMP is anticipated to manage not only lizard populations along the berm of the foredunes and on the private land proposed as a site establishment/storage area; but also, to manage the skink populations of the DCC Reserve during the planned rehabilitation of the site (Angus Robertson, DCC, pers. comm 2018; see Appendix 7).

The process to identify which areas can be avoided will broadly adhere to the following principles:

- An on-site briefing of contractors, prior to works commencing, will be carried out by the project herpetologist who will explain the location and the purpose of the “no-go” zones.
- During information exchange, the project herpetologist will explain where lizards and their habitat exist, and the contractor will explain the minimum site requirements to carry out construction (this then becomes the agreed maximum construction footprint to which a buffer is then applied).
- Where the footprint overlaps with skinks and their habitat, a discussion will be had between both parties to determine if alternate locations, away from skink habitat could be used instead, without compromising
 - Other indigenous biodiversity;
 - Health & Safety of contractors;
 - Duration and/or intensity of works; and
 - Any consent conditions relating to the site.
- Following agreement on the location and extent of the maximum construction footprint, the no-go areas will be georeferenced and mapped for inclusion in the LMP; and then marked on ground with waratahs and flagging tape.
- The location of lizard habitat, including a 2-5 m buffer (depending on site, lizard density and habitat) will be marked on the ground as a “no-go zone” for all activities, including foot-traffic.

10. Adaptive Management of Marine Effects

An adaptive management approach is commonly adopted in New Zealand for managing effects that have a large element of uncertainty, or for which scientific or best practice data essential in accurately predicting the scale and significance of effects, are lacking. This, in our view, describes effects of the Te Rauone scheme on the marine benthic environment. For the terrestrial elements of the scheme, effects are much more predictable and as noted below,

we propose the effects of the scheme of indigenous lizards are managed within a standalone lizard management plan, the proposed content of which is detailed below. Furthermore, an adaptive management regime for the marine environment, informed by outcome monitoring (see below), is best captured by conditions of consent relating to an Environmental Management Plan, rather than within an EA. With this in mind, an overview of the adaptive management framework proposed is provided here.

Marine Benthic Communities Including Cockle Beds

Section 8 highlights the following actual and potential adverse effects of the scheme on the *existing marine benthic environment*, that require adaptive management. These effects are:

1. Loss of Marine Benthic Habitat and Death of Localised Infauna and Epifauna;
2. Effects of Physical Disturbance by Vehicles;
3. Increases in Local Turbidity;
4. Rock groynes as a biosecurity issue; and
5. Cockles and Other Shellfish Communities- Effects of Physical Disturbance.

Our baseline data, with which to assess the scale and severity of any effects that occur over the scheme footprint as a result of scheme-works can be summarised as follows:

- A series of marine benthic core samples from within (impact) and adjacent (control) to the scheme footprint to set up a BACI design (before, after, control impact).
- Visual quadrat surveys from within (impact) and adjacent (control) to the scheme footprint to set up a BACI design (before, after, control impact).

Remediation of Marine Benthic Environment

A two-pronged approach to managing these effects is proposed here; namely monitoring and then remediation should pre-set thresholds be met; thresholds will be detailed in an Environmental Management Plan and conditions of consent and will include timebound species richness and density thresholds. Rehabilitation (as opposed to remediation) methods for soft-sediment fauna and flora are limited. The reason for this knowledge gap in marine biology practice is that such efforts would be overrun in terms of efficiency, by natural rehabilitation given the inherent ability of these communities to adapt to natural disturbance, an integral feature of their life history. It is for this reason, and our experience of the relatively low-value resilient biota that occupy the Te Rauone beach area, that no specific rehabilitation is proposed for benthic communities themselves. Instead, should the proposed monitoring (see below) of the Te Rauone marine benthic communities (including cockles) of the scheme's footprint demonstrate unequivocal negative effects attributed to the scheme, two actions could be undertaken:

- The quantity of sediment used for beach top-ups could be reduced, or stopped entirely; and
- The source of sediment can be altered to better match existing sediment on the beach

(i.e. sediment will then be sourced solely from an intertidal area of the harbour).

Monitoring of Marine Benthic Environment

To determine the re-colonisation rates of benthic fauna following the disturbance of creating the groynes, and to monitor the overall health of the benthic communities (that maybe adversely affected by increased local turbidity following sediment deposition); benthic sampling will be undertaken at six months following the completion of the scheme works. Further monitoring will only continue if considered necessary after analysis of this sampling through the adaptive management process proposed. Note: no monitoring is planned for the marine benthic environment, including cockle beds *during* works.

Rock Groynes as a Biosecurity Issue

As discussed above in Section 8, rock to construct the groynes will be sourced from a land-based quarry and as such, will be “clean” of marine fauna and flora when introduced onsite. For this reason, no management actions are required for this potential effect.

Southern Seagrass beds

Section 8 highlights the following actual and potential adverse effect of the scheme on the existing *southern seagrass beds*, outside of the scheme footprint, that require adaptive management. This effect is:

1. Increases in Local Turbidity.

Our baseline data, with which to assess the scale and severity of any effects that occur over the southern seagrass beds as a result of scheme-works can be summarised as follows:

- A series of fourteen aerial photos for Harwood and Papanui seagrass beds in Spring and Autumn; including the seagrass beds at Te Rauone dating back to December 2015 to June 2019 (see Appendix 6).

Potential Remediation of Southern Seagrass Beds

A three-pronged approach to managing these effects is proposed here; namely monitoring and then remediation should pre-set thresholds be met, followed by rehabilitation of the beds over the longer term. Thresholds to trigger remediation and rehabilitation will be detailed in an Environmental Management Plan and through the conditions of resource consent, and will include reductions in seagrass distribution, extent and relative condition.

In the event that seagrass beds are observed to be detrimentally affected by the scheme (e.g. if more than 30 % of seagrass beds are lost between surveys, attributed to construction works and not as a result of other factors, such as weather or seasonal patterns), remediation methods will be put in place through the proposed adaptive management process. Remediation methods could include:

- That further “top-ups” of sediment onto Te Rauone beach will cease until sandbags

are placed at the southern seagrass bed, on the border towards the northern end of the beach.

- Rehabilitation could be undertaken by POL if seagrass beds demonstrate no recovery after one year following such losses (through sediment removal and transplantation). This could include transplantation to move plants to the affected beds from a healthy bed (e.g., Papanui, or another nearby bed at Harwood). Matheson *et al.* 2017⁶³ described successful transplants of *Zostera* (seagrass) in Whangarei Harbour with plant cover increasing from <1 up to 79 % after nine months, and at the end of 18 months, plant cover was retained at 64 % and 62 % for two different methods trialled.

No actions are planned should tidal flats, anticipated to be created by the Te Rauone scheme, fail to become colonised by seagrass. To be clear, rehabilitation will not be triggered by the failure of seagrass to establish on any new tidal flats within the scheme footprint, but by the reduction in extent, distribution, and relative condition of the southern seagrass beds, situated outside and south of the footprint (shown in Figure 5).

Monitoring of the Southern Seagrass Beds

Monitoring of the southern seagrass beds, which occur south of the scheme footprint, will be undertaken while the works are being completed to ensure suspended sediment loads do not exceed physical limits (i.e. to ensure beds are not smothered by sediment). An aerial survey using a drone will be undertaken every four weeks during works to determine the distribution, extent and relative condition of the beds, and the relative sediment-loading of them. Seagrass bed extent and distribution and condition will be compared with aerial survey photos from 2015-2019 (Appendix 6). As noted above, sampling the seagrass bed by taking core samples would require extensive sampling to allow for the patchiness within a healthy bed of seagrass. The sampling required would likely be detrimental by removing shoots vital to the bed; it is for this reason that aerial surveys are proposed.

In addition, aerial surveys will continue to be undertaken in Spring and Autumn for three years post-works, to ensure the renourishment works including intermittent “top-ups” of sediment to the beach, does not adversely affect the *Zostera* (seagrass) beds.

11. Sea Mammal Management

Section 8 highlights the following actual and potential adverse effect of the scheme on the *existing sea mammals*, that requires management. This effect is:

1. Noise, vibration and human presence & Temporary Displacement

⁶³Matheson, F. E., Reed, J., Dos Santos, V. M., Mackay, G., & Cummings, V. J. (2017). Seagrass rehabilitation: successful transplants and evaluation of methods at different spatial scales. *New Zealand Journal of Marine and Freshwater Research*, 51(1), 96-109.

Our baseline data, with which to assess the scale and severity of any effects that occur over the sea mammals as a result of scheme-works can be summarised as follows:

- Frequency of sightings in and around the scheme footprint, and knowledge of where sea lions preferentially spend time around Otago Harbour.

It is acknowledged that there may be potential impacts on marine mammals should they be encountered during the scheme works and under the Marine Mammals Protection Act (1992), it is an offence to harass or drive a vehicle within 50-metres of any marine mammal on the beach. With this in mind, management of sea lions will be detailed in the Environmental Management Plan. This will include the requirement for a sea lion expert to conduct an on-site briefing to contractors, as to the protocols DOC/the Plan requires, prior to all works commencing.

12. Bird Management

As noted in Section 8, it is expected that the majority of adverse effects of the scheme on resident birds will be temporary effects, such as disruption of inter-tidal foraging as the works are taking place. The permanent removal of some resting habitat, is also planned. The creation of three 70-80 m rock groynes will produce extensive resting and roosting habitat for birds, more than that planned for removal. With this in mind, any temporary and permanent adverse effects will be completely offset by the creation of these rock groynes, meaning no extra management is considered necessary for birds (also see Birds, Potential Positive Effects in Section 8).

13. Lizard Management

To carry out scheme works over habitat of the at-risk southern grass skink, a Wildlife Act permit is required from the Department of Conservation⁶⁴. Given the POL beach management scheme and the planned DCC makeover of the Te Rauone Recreation Reserve are planned to occur in sequence, it is recommended that the resident southern grass skink population is managed as a single entity under a site-specific lizard management plan. DOC will require that this plan will seek to achieve a no-net-loss in lizard values over the site as a result of both the DCC Te Rauone Recreation Reserve makeover project and the POL beach management scheme. Such a plan would ideally have a focus on avoiding existing lizard habitat, and augmenting the Te Rauone Recreation Reserve with lizard habitat (see next Section). For areas of the scheme footprint where southern grass skink habitat and/or southern grass skinks cannot be avoided; DOC will likely require affected skinks to be captured and relocated to safe habitat elsewhere. This habitat will need to be shown to have capacity to take the

⁶⁴ Note: DOC can take more than 6-weeks to process such a permit and the permits are issued with conditions that attempt to align with resource consent conditions if both processes are run concurrently.

new-comers which may necessitate predator control being undertaken, and on-going monitoring of the fate of released skinks.

Site rehabilitation of the foredunes, and the remainder of the Te Rauone Recreation Reserve/Domain will be undertaken by DCC; a preliminary concept plan (dated September 2018) is included here as Appendix 7. As part of the management of lizard values both over the scheme footprint, and the Te Rauone Recreation Reserve as rehabilitation is progressed, it is recommended here that the Lizard Management Plan has an action to rehabilitate at least part of the Te Rauone Recreation Reserve into 'lizard-friendly' habitat, including the addition of rock-substrate and low-growing indigenous plants that provide food for lizards.

14. Suggested Consent Conditions

Consent conditions have been provided in collaboration with GHD and the applicant and are provided within Appendix G of the AEE titled "Port Otago Ltd Te Rauone Beach - Rock Groynes and Sand Re-nourishment Resource Consent Application (Revised)", written by GHD and dated April 2020. These conditions take into account the above mitigation measures.

15. Conclusion

Although Te Rauone Beach Recreation Reserve and the scheme footprint have significant ecological values present, a mix of avoidance and adaptive management proposed here, in combination with the positive effects of the scheme, will ensure a no-net-loss in values, post works.

Appendix 1: Letter from DOC

Andy Pullar

From: Jessica Richards <jerichards@doc.govt.nz>
Sent: Thursday, 4 July 2019 9:40 a.m.
To: Andy Pullar
Cc: Craig Wilson
Subject: RE: Port Otago - Te Rauone Beach

Hi Andy,

We have been looking over your application and there are a few issues of concern regarding the questions raised in the last letter.

On the face of it and from the information we have received we see a lot of benefits to the work being done, such as a place for sea lions to breed and rest, a place for sea birds to roost, introduction of an ecological rocky coastline that has been lost, a stable sandy beach in that area and a way to mitigate the issues we face from the impacts of climate change.

However, to provide meaningful feedback the Department requires more information on how Port Otago intends to conduct the work, such as:

1. How the work will be completed and what steps will be taken when encountering marine mammals such as sea lions (Te Ruaone beach is a popular spot for sea lions to breed) during the restoration work, i.e.
 - if it is likely there will be diggers or barges used, the Department may have to propose consent conditions to ensure work is not done during breeding season (sea lions: Jan-Feb), or
 - If the work proposed during breeding season is less invasive, what steps will be taken to prevent minimal disturbance to the sea lions and other marine mammals in the area.
 - Therefore, we will require specific details on what method will be used to conduct the works to determine environmental impacts and ways to reduce harm.

2. There was no environmental impact assessment included in the bundle of documents that you provided us on the proposed works, such information would need to be included in your application.
 - An example of this may be general information on how the rock groynes would change/impact protected species or areas of significance (such as the benthic environment) in or around Te Ruaone beach. The Department does not require in-depth detail on this matter, i.e. exactly what type of sea worm may be impacted in the benthic environment but generally how such work would impact/change the environment both during and after the works are completed.

I hope this helps and if you have any further question or need further clarification, please feel free to contact myself or Craig.

Kind regards,

Jess Richards and Craig Wilson

Jess Richards | Department of Conservation
Community Ranger- *Kaitiaki Āo Hāpori*
Ōtepoti / Dunedin Office
M +64 27 273 3071 | T +64 3 477 0677
Conservation leadership for our nature | Tākina te hī, Tiakina te hā, o te Āo Tūroa

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Appendix 2: Benthic Infauna Communities in the Control Area

| Species | Control Transect 1 | | | | | | | | | Control Transect 2 | | | | | | | | | Control Transect 3 | | | | | | | | | | |
|-----------------------------------|--------------------|------|------|-----|-----|-----|-----|-----|-----|--------------------|------|------|-----|-----|-----|-----|-----|-----|--------------------|------|------|-----|-----|-----|-----|-----|-----|-----|----|
| | High | High | High | Mid | Mid | Mid | Low | Low | Low | High | High | High | Mid | Mid | Mid | Low | Low | Low | High | High | High | Mid | Mid | Mid | Low | Low | Low | | |
| Nemertea | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | |
| Nematoda | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| Gastropoda | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Eatonella sp. | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | |
| Bivalvia Unid. (juv) | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| Lasaëidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nuculidae | | | | 1 | | | | | | | | 1 | 18 | 4 | | | | | | | | 5 | | | | 7 | 1 | | |
| Arthritica bifurca | | | | | | | | | | | | 3 | | 4 | | | | | | | | | | | | | | | |
| Austrovenus stutchburyi (0-5mm) | | | | | | 1 | | 2 | 1 | | | | | | | | | | | | | | | 1 | | | | | |
| Austrovenus stutchburyi (06-10mm) | | | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| Austrovenus stutchburyi (31+mm) | | | | | | | | | | | 1 | | | | | | | | | | 3 | | | | | 1 | | | |
| Dosinia sp. (Juvenile) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mysella unidentata | | | | 5 | 15 | 10 | 26 | 12 | 21 | | | 1 | 72 | 25 | 78 | 2 | 15 | 5 | | | 4 | 1 | 55 | 37 | 39 | 37 | 30 | 80 | |
| Ostrea chilensis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Perrierina (Legrandina) turneri | 2 | 5 | 11 | 19 | 32 | 55 | 80 | 92 | 99 | 1 | 5 | 15 | 454 | 377 | 206 | 7 | 27 | 123 | | | 77 | 24 | 69 | 127 | 151 | 148 | 15 | 31 | 34 |
| Ruditapes largillierti | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Tawera spissa | | | | | | | | | | | | | 3 | | | | | | | | 1 | | | | | | | | |
| Oligochaeta | | | | | | | | | | | | 1 | 2 | 2 | | | | | | | | | 1 | | | | 1 | 5 | |
| Polydorid | | | | | | | | | | | | 1 | | 1 | | | | | | | | | | | | | | | |
| Nereididae | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| Naineris laevigata | | | 2 | | 1 | | | | 1 | | | 2 | 2 | 2 | | | | | | | | | | | | 2 | 2 | 4 | |
| Scoloplos sp. | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| Spionidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Prionospio aucklandica | | | | | | | | | | | | | 2 | | 5 | | | | | | 1 | | | | | | 2 | | |
| Prionospio multicristata | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | | | | |
| Prionospio sp. | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Spio sp. | 1 | | | | | | 1 | | | | | 11 | 21 | 15 | | | | | | | | 1 | | 3 | 4 | 5 | 3 | | |
| Notomastus sp. | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 2 | 1 | |
| Macroclymenella stewartensis | | | | 9 | 8 | 8 | 8 | 9 | 8 | | | 22 | 21 | 22 | 10 | 9 | 14 | 4 | 4 | 8 | 13 | 7 | 22 | 16 | 17 | 22 | | | |
| Ophelidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Armandia maculata | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Travisia sp. | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | |
| Phyllodoceidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hesionidae | | | | 1 | | | | | | | | | 1 | | | | | | | | | | | | 1 | | | | |
| Exogoninae | | | | 3 | 1 | | | 2 | 1 | | | 2 | 4 | 16 | 3 | | | | | | | 1 | 7 | 18 | 2 | 7 | 14 | | |
| Syllidae | | | | 2 | 6 | 2 | | 4 | 6 | | | 30 | 13 | 42 | 1 | | | 5 | 3 | 1 | | 1 | 6 | 4 | 7 | 4 | 5 | | |
| Nereididae (juvenile) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Neanthes cricognatha | | | | 1 | | | | | | | | | | | 1 | | | | | | 4 | | 1 | | 1 | 1 | 1 | 3 | |
| Perinereis sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Platynereis australis | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | 1 | 1 | | | |
| Glyceridae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Goniadidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aglaothamus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Cirratulidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Terebellidae | | | | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | 1 | 3 | |
| Euchone sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 4 |
| Nebaliacea | | | | 3 | | | 2 | | | | | 4 | 20 | 3 | | | | | | | | | | | | | 11 | 11 | 4 |
| Tanaidacea | 1 | | | 34 | 11 | 5 | 17 | 6 | 7 | | | 1 | 214 | 201 | 137 | 1 | 9 | 3 | 3 | | | | 111 | 57 | 254 | 111 | 123 | 128 | |
| Stomatopoda | | | | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Cumacea | 1 | | | 1 | | 10 | 1 | 10 | 11 | | | | 3 | 14 | 33 | 1 | 7 | 2 | | | 1 | | 6 | 11 | 12 | 17 | 24 | 17 | |
| Isocladus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pseudogaega sp. | 1 | 4 | 2 | | | | | | | 2 | 1 | 1 | | | | | | | | | | | 1 | | | | | | |
| Asellota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acrididae | | | | | 1 | | 1 | 2 | | | | | 3 | 1 | | | | | | | | | | 4 | 4 | 3 | 8 | 3 | |
| Carillopiidae | | | | | 2 | | | | | | | | 3 | 3 | 2 | | | | | | | | | | 3 | 2 | | 6 | |
| Corophiidae | 1 | | | 16 | | | | | 1 | | 4 | 19 | | 1 | | | | | | | 11 | 14 | 11 | 2 | | | | | |
| Liljeborgiidae | | | | | | 1 | | | | | | | 1 | | | | | | | | | | | | | | | | |
| Lysianassidae | | | | | | | | | 1 | | | | 5 | 1 | | | | | | | | | | | | | | | |
| Oedicerotidae | | | 1 | | | | | 3 | 1 | | | | | | 1 | | 2 | | | | | | | | | 1 | 2 | 3 | 3 |
| Phoxocephalidae | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 1 |
| Fontogeniidae | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | |
| Coxophoxus sp. | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | | 5 | 2 | 1 |
| Heterophoxus sp. | | | | | 4 | | 1 | | 1 | | | | 8 | 3 | 6 | 1 | 1 | | | | | | 3 | | 6 | 3 | 7 | 5 | |
| Torridoharpinia hurleyi | 1 | | | 5 | 1 | 5 | 6 | 8 | 6 | | | | 19 | 23 | 21 | | 7 | 9 | | | 16 | 2 | | 15 | 9 | 14 | 11 | 22 | 16 |
| Waitangi sp. | 1 | 3 | | 8 | 9 | 10 | 6 | 14 | 17 | | | | 11 | 6 | 3 | 9 | 8 | 7 | | | | | | 7 | 14 | 7 | 12 | 2 | 4 |
| Amphipoda indet. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Callinassa filholi | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Ostracoda | | | | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | |
| Count: No of Individuals | 6 | 15 | 32 | 99 | 90 | 109 | 150 | 165 | 182 | 3 | 13 | 71 | 876 | 779 | 565 | 35 | 85 | 170 | 117 | 59 | 91 | 354 | 304 | 546 | 269 | 316 | 365 | | |
| Count: No of Taxa | 5 | 6 | 5 | 16 | 13 | 12 | 12 | 13 | 15 | 2 | 5 | 9 | 26 | 25 | 26 | 9 | 9 | 10 | 9 | 11 | 6 | 18 | 11 | 25 | 25 | 25 | 25 | | |

Appendix 3: Benthic Infauna Communities in the Impact Area (Scheme Footprint)

| Species | Impact Transect 1 | | | | | | | | | Impact Transect 2 | | | | | | | | | Impact Transect 3 | | | | | | | | | |
|-----------------------------------|-------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-------------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----|
| | High | High | High | Mid | Mid | Mid | Low | Low | Low | High | High | High | Mid | Mid | Mid | Low | Low | Low | High | High | High | Mid | Mid | Mid | Low | Low | Low | |
| Nemertea | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| Nematoda | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gastropoda | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | |
| Eatonella sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bivalvia Unid. (juv) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lasaeidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nuculidae | | | | | | | | 3 | 1 | | | | | | | | | | | | | | | | 2 | | | |
| Arthritica bifurca | | | | | | | | 1 | 1 | 1 | | | | 1 | | | | | | | | | 1 | | 4 | 7 | | |
| Austrovenus stutchburyi (0-5mm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Austrovenus stutchburyi (06-10mm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Austrovenus stutchburyi (33+mm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dosinia sp. (Juvenile) | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | |
| Mysella unidentata | | 3 | | | 6 | 4 | | 16 | | | | | | | | | | | | | | | | 9 | 1 | 14 | 18 | 20 |
| Ostrea chilensis | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Perrierina (Legrandina) turneri | 1 | 1 | 1 | 1 | 1 | 1 | 16 | | | | | | | | | | | | | | | | | | | | | |
| Ruditapes largillierti | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tawera spissa | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oligochaeta | | | | 1 | | | | | | | | | | | | | | 8 | | | | | | | | | 1 | |
| Polydorida | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| Nereididae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Naineris laevigata | | | | | | | 1 | | | | 1 | 2 | | | | | | | | | | | | | 1 | | | |
| Scoloplos sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spionidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Prionospio aucklandica | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Prionospio multicristata | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Prionospio sp. | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Spio sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| Notomastus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Macroclymenella stewartensis | | 1 | | | 1 | 3 | 7 | 3 | 13 | 4 | | | | | | | | | | | | | | | | | | |
| Opheliidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Armandia maculata | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Travisia sp. | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Phyllocladidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hesionidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Exogoninae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Syllidae | | | | | 1 | 2 | 1 | 3 | 4 | 1 | | | | | | | | | | | | | | | | | 1 | |
| Nereididae (juvenile) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Neanthes cricognatha | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Perinereis sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Platynereis australis | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Glyceridae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Goniadidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aglaophamus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cirratulidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Terebellidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Euclione sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nebaliacea | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tanaidacea | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Stomatopoda | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cumacea | | 1 | | | 1 | 2 | 2 | 1 | 3 | 1 | | | | | | | | | | | | | | | | | | |
| Isocladus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pseudaega sp. | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asellota | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aoridae | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | |
| Calliopidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Corophiidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Liljeborgiidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lysianassidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oedicerotidae | | | | | | 6 | | | | | | | | | | | | | | | | | | | | | | |
| Phoxocephalidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pontogenidae | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Coxophoxus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heterophoxus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Torridoharpinia hurleyi | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Waitangi sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amphipoda indet. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Callianassa filholi | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ostracoda | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Count: No of Individuals | 2 | 9 | 4 | 39 | 25 | 35 | 48 | 64 | 35 | 4 | 30 | 13 | 58 | 30 | 40 | 116 | 56 | 49 | 1 | 16 | 3 | 40 | 32 | 18 | 61 | 50 | 69 | |
| Count: No of Taxa | 2 | 6 | 3 | 11 | 10 | 9 | 14 | 12 | 11 | 4 | 8 | 7 | 13 | 10 | 11 | 21 | 15 | 16 | 1 | 6 | 2 | 7 | 9 | 7 | 14 | 13 | 15 | |

Appendix 4a: 2GP Section 6c (RMA 1991) criteria

Policy 2.2.3.2

Identify as areas of significant indigenous vegetation and/or as significant habitats of indigenous fauna areas which meet one or more of the following criteria:

- a. Protected areas: existing protected areas set aside by statute or covenant or listed in an operative Otago Regional Council Regional Plan as having significant indigenous biodiversity value;
- b. Rarity: areas that support:
 - i. habitat for indigenous species that are threatened, at risk, or uncommon, nationally or within an ecological district;
 - ii. indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent nationally, regionally or within a relevant land environment, ecological district or freshwater environment including wetlands; or
 - iii. indigenous vegetation and habitats within originally rare ecosystems;
- c. Representativeness: areas that are examples of an indigenous vegetation type or habitat that is typical or characteristic of the natural diversity of the relevant ecological district, which may include degraded examples of their type or represent all that remains of indigenous vegetation and habitats of indigenous fauna in some areas;
- d. Distinctiveness: areas that support or provide habitat for:
 - i. indigenous species at their distributional limit within Dunedin or nationally;
 - ii. indigenous species that are endemic to the Otago region; or
 - iii. indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, or has developed as a result of an unusual environmental factor or combinations of factors;
- e. Ecological Context: areas important for their ecological context, including areas that:
 - i. have important connectivity value allowing dispersal of indigenous vegetation and fauna between different areas;
 - ii. perform an important buffering function that helps to protect the values of an adjacent area or feature; or
 - iii. are important for indigenous fauna, on a regular or temporary basis, for breeding, refuge, feeding or resting;
- f. Diversity: areas that support a high diversity of indigenous ecosystem types, indigenous taxa or have changes in species composition reflecting the existence of diverse natural features or gradients; or
- g. Size: areas that are of a size to make them significant.

Appendix 4b: Assessment of Vegetation & Fauna Habitats against 2GP Criteria

Note: An asterisk * denotes significant vegetation that lies within the scheme footprint.

| Policy 2.2.3.2 Criterion | Pikao plantings in Te Rauone Domain | Pohuehue vineland in Te Rauone Domain* | Indigenous plantings in Te Rauone Domain | Rank grassland in Te Rauone Domain | Pohuehue vineland in private land (storage/site establishment area) * | Rank grassland in private land (storage/site establishment area) |
|-----------------------------|--|--|---|--|---|--|
| Protected Areas | - | - | - | - | - | - |
| Rarity | At risk declining pikao present | southern grass skinks present | southern grass skinks present | - | southern grass skinks present | - |
| Representativeness | - | - | - | - | - | - |
| Distinctiveness | - | - | - | - | - | - |
| Ecological Context | - | some value for southern grass skinks | some value for southern grass skinks | - | - | - |
| Diversity | - | - | - | - | - | - |
| Size | - | - | - | - | - | - |

Appendix 5: Plant Species list from laydown/site establishment site

lant species recorded from survey area. Exotic plant species are indicated with an asterisk (*).

| Scientific Name | Common Name | Abundance | Approximate % Cover |
|--------------------------------|--------------------------|------------|---------------------|
| <i>Adlumia fungosa</i> * | Climbing fumitory | Occasional | 1 |
| <i>Agrostis tenuis</i> * | Brown top | Common | 20 |
| <i>Anthoxanthum odoratum</i> * | Sweet vernal | Common | 15 |
| <i>Cytisus scoparius</i> * | Scots broom | Occasional | 5 |
| <i>Dactylis glomerata</i> * | Cockfoot | Common | 15 |
| <i>Geranium molle</i> * | Dove's-foot crane's-bill | Common | 3 |
| <i>Holcus lanatus</i> * | Yorkshire fog | Common | 5 |
| <i>Hypochaeris radicata</i> * | Cats ear | Common | 10 |
| <i>Juncus sp.</i> | Juncus | Occasional | 1 |
| <i>Lupinus luteus</i> * | Yellow lupin | Common | 10 |
| <i>Muehlenbeckia australis</i> | pohuehue | Occasional | 1 |
| <i>Plantago major</i> * | Broad leaved plantain | Occasional | 1 |
| <i>Pteridium esculentum</i> | Bracken fern | Common | 2 |
| <i>Rubus fruticosus</i> * | Blackberry | Occasional | 1 |
| <i>Rumex acetosella</i> * | Sheep sorrel | Common | 2 |
| <i>Solanum nigrum</i> * | Black nightshade | Rare | 0.5 |
| <i>Sonchus oleraceus</i> * | Common sow thistle | Rare | 0.5 |
| <i>Stellaria media</i> * | Chickweed | Common | 2 |
| <i>Trifolium pratense</i> * | Red clover | Occasional | 1 |
| <i>Trifolium repens</i> * | White clover | Occasional | 1 |
| <i>Ulex europaeus</i> * | gorse | Occasional | 3 |
| Total | | | 100 % |

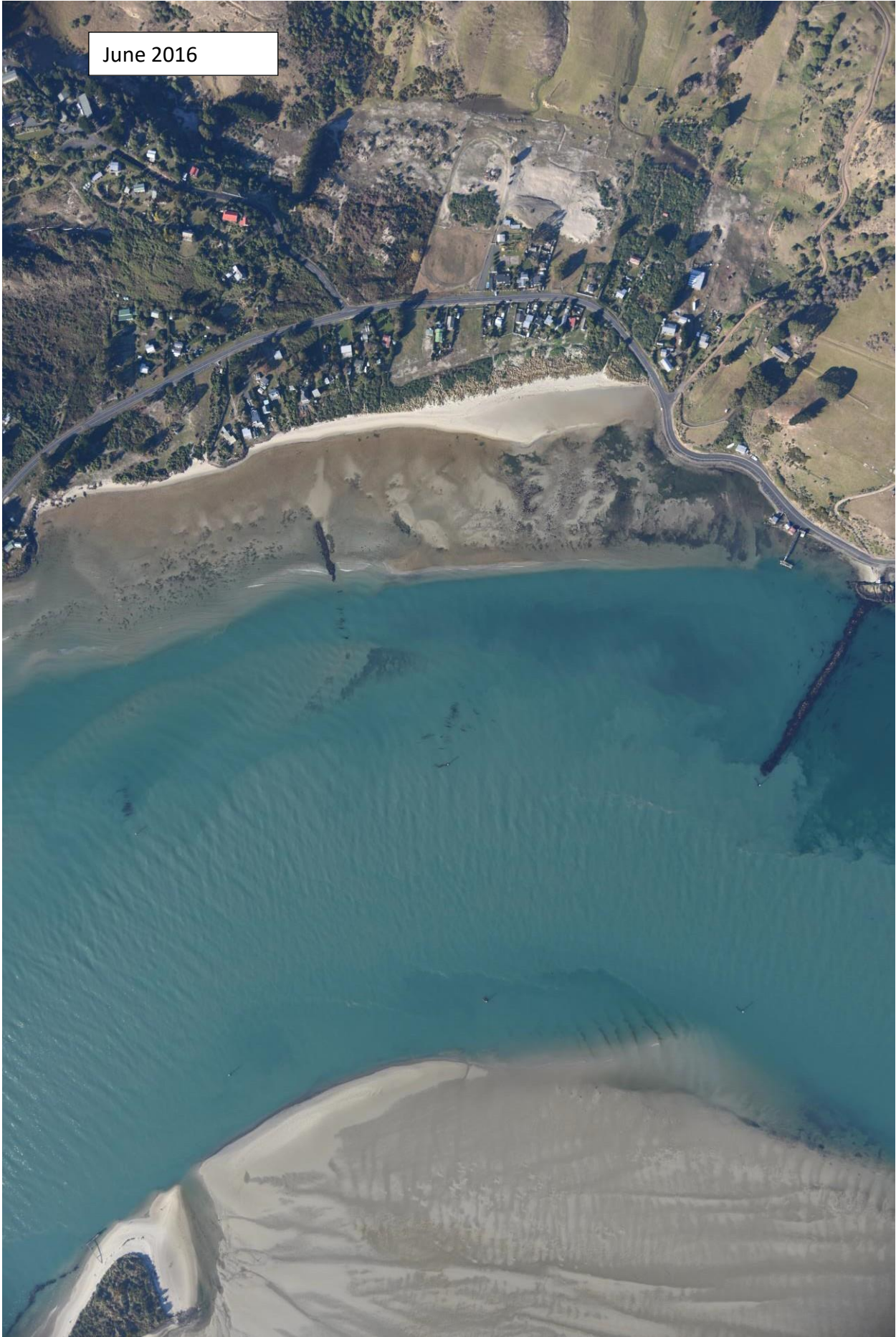
Appendix 6: Aerial Photos taken of Te Rauone Seagrass beds between 2015-2019







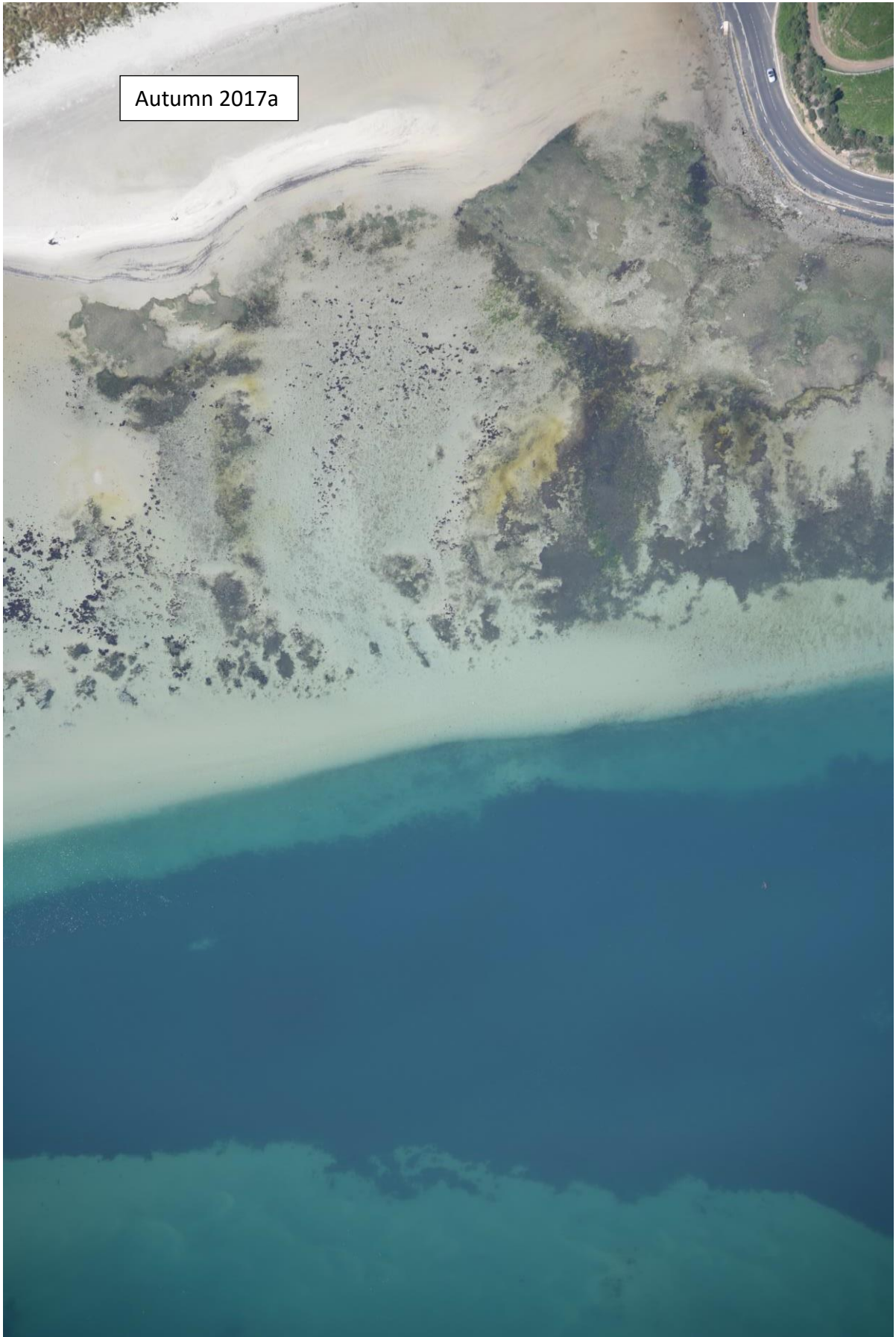
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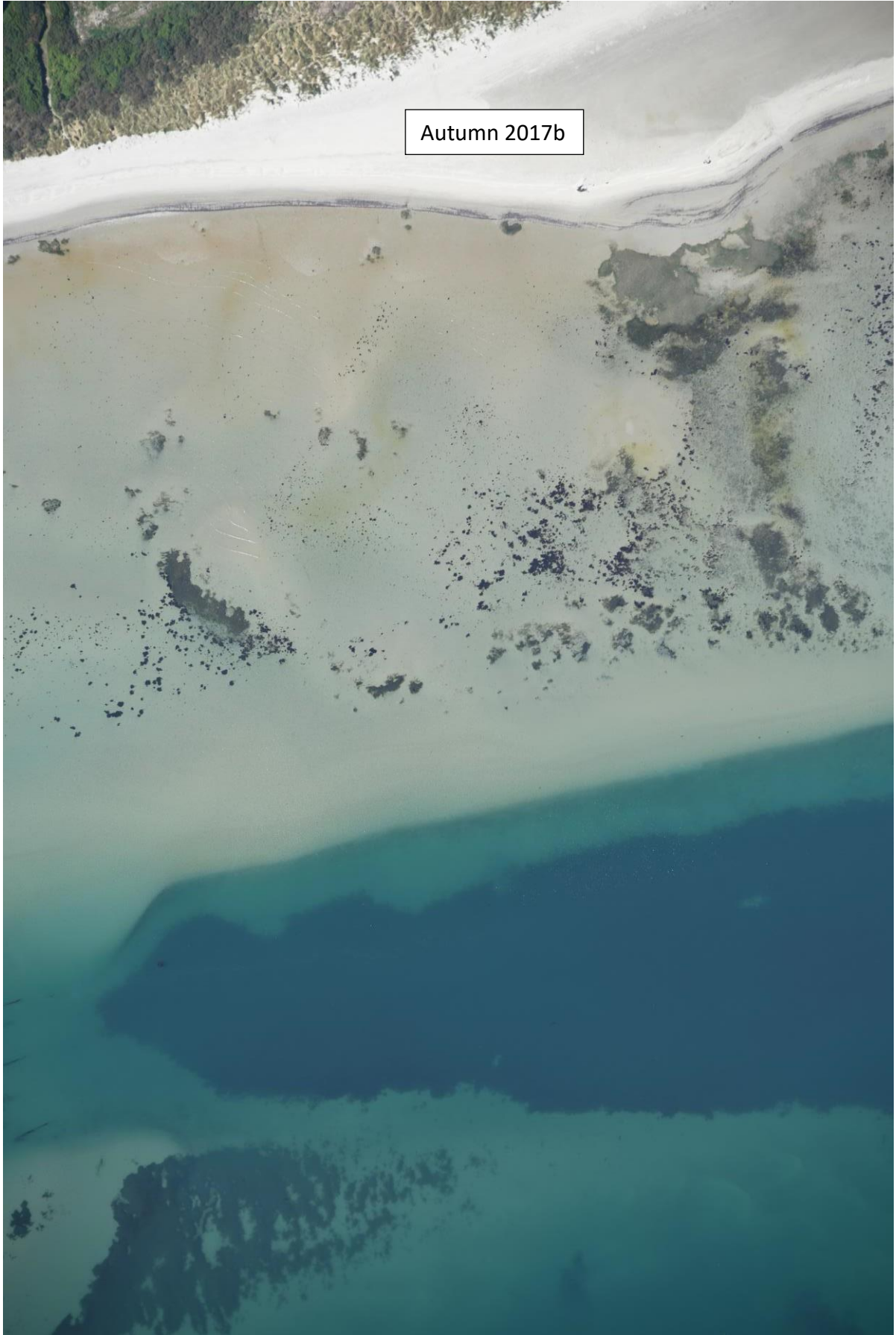




October 2016a







Autumn 2017b



Autumn 2017 c

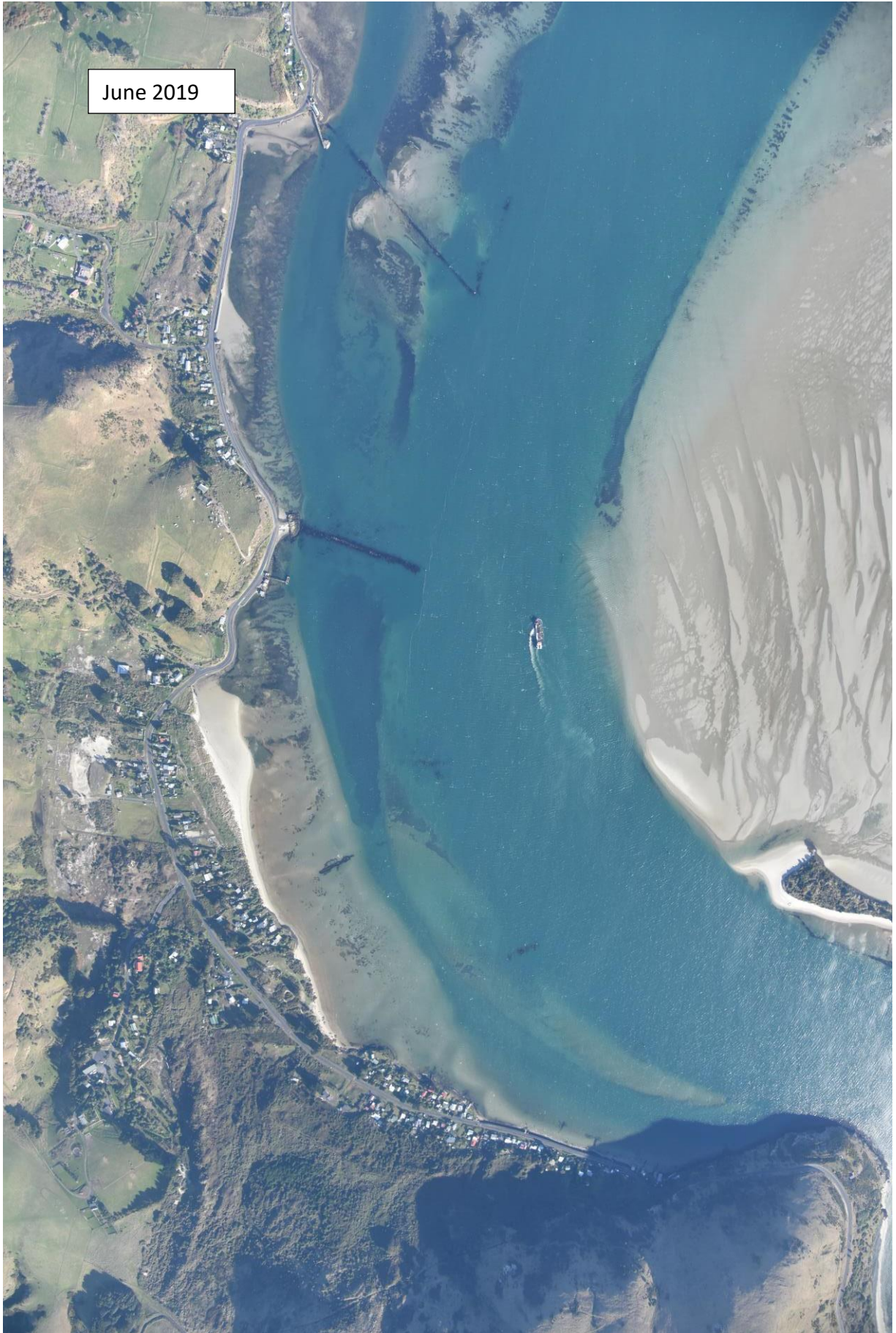


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August 2017





Appendix 7: DCC Concept Plan for Restoration of the Te Rauone Recreation Reserve (from ODT 27th September 2018)



Appendix F – Coastal Processes Assessment

Te Rauone Beach Management Scheme - Assessment of Effects on Coastal Processes

Prepared for Port Otago Ltd
Prepared by Beca Limited

12 March 2020



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Appendices


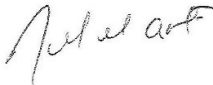
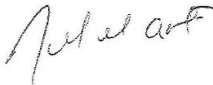
Appendix A -References

Appendix B – Drawings

Revision History

| Revision N° | Prepared By | Description | Date |
|-------------|---------------|---------------------------------------|-------------|
| A | Ian Goss | Draft for Discussion | 20 Nov 2019 |
| B | Ian Goss | Review Comments Incorporated | 28 Nov 2019 |
| C | Jennifer Hart | Updated issue for consent application | 12 Mar 2020 |
| | | | |
| | | | |

Document Acceptance

| Action | Name | Signed | Date |
|--------------|---|--|-------------|
| Prepared by | Ian Goss / Jennifer Hart (amendments only) |  | 12 Mar 2020 |
| Reviewed by | Jennifer Hart / Ian Goss (amendments only) |  | 12 Mar 2020 |
| Approved by | Jennifer Hart |  | 12 Mar 2020 |
| on behalf of | Beca Limited | | |

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Executive Summary

This report presents an assessment of the coastal effects of the proposed Beach Management Scheme at Te Rauone. The intention of the project is to provide beach amenity including an above tide useable beach berm on a section of coastline on the Otago Harbour that has been subject to significant and ongoing retreat over the last century. The scheme proposed has been developed over a number of years, and is based on current coastal engineering procedures and understanding of the Otago Harbour physical environment, and is the preferred approach established as the outcome of ongoing consultation between Port Otago Limited and the Te Rauone Beach Coast Care Committee. Alternative options to the preferred scheme were considered and are outlined.

The preferred scheme which will be implemented by Port Otago Limited comprises:

- *Three 70 to 80m long rock groynes that are necessary to establish and retain the added sand volume in place, and to provide a degree of protection to it from the coastal processes that are presently acting on the site, resulting in net transport of the removed beach sand along the beach to the south.*
- *The renourishment of a 300m section of sandy foreshore with sand recovered from the harbour channel, which will provide the amenity component to the beach and comprise a “soft” coastal component that is able to respond and adapt to coastal processes.*

The report describes the components and their features in detail including the design approach and measures incorporated to accommodate site specific performance requirements, the construction procedure and sequence, the setting of the site in terms of coastal characteristics and the extent and effects of artificial modifications made to the harbour environment.

It then describes the local coastal environment and features, drawing on numerous previous investigations including the substantial work carried out to assess the effects of the harbour dredging project.

The effects of the proposed works, both long term and including construction operations, on the coastal components identified are discussed and evaluated in terms of perceived significance, including effects on.

- *Tides and currents*
- *Wind*
- *Waves and surge*
- *Shoreline change and sediment transport processes*
- *General harbour and surf break conditions*

Procedures for regular monitoring, maintenance and mitigation works to support the performance of the design, and in consideration of the design life of the scheme are proposed and discussed. These include the recycling of sand to the renourished area in response to observation of performance, and the addition of more renourishment material from the channel.

The assessment concludes that taking into consideration the proposed construction procedure, monitoring and mitigation, coastal processes effects will be minor in the context of the negligible effects on the wider harbour, the beneficial effect on the northern section of the beach, and the proposed ongoing monitoring, mitigation and maintenance to support the positive improvement of amenity at Te Rauone Beach.

1 Introduction

Consent is being sought by Port Otago Ltd (POL) to provide improved coastal amenity at Te Rauone Beach on the eastern shore of Otago Harbour (refer to Figures 1 and 2). The proposal is to restore a section of beach with a minimum 5m wide high tide berm along the northern 300m of Te Rauone Beach using sand dredged from the main navigation channel.

Beca Ltd has been commissioned by POL to prepare an assessment of the effects of the proposed scheme on coastal processes, based on existing information. Accordingly, this report sets out:

- The background to the proposed scheme.
- The proposed works and their intended function.
- A description of the existing coastal processes.
- An assessment of the effects of the proposed scheme on coastal processes.
- Mitigation and monitoring measures proposed.
- Conclusions in relation to coastal effects.

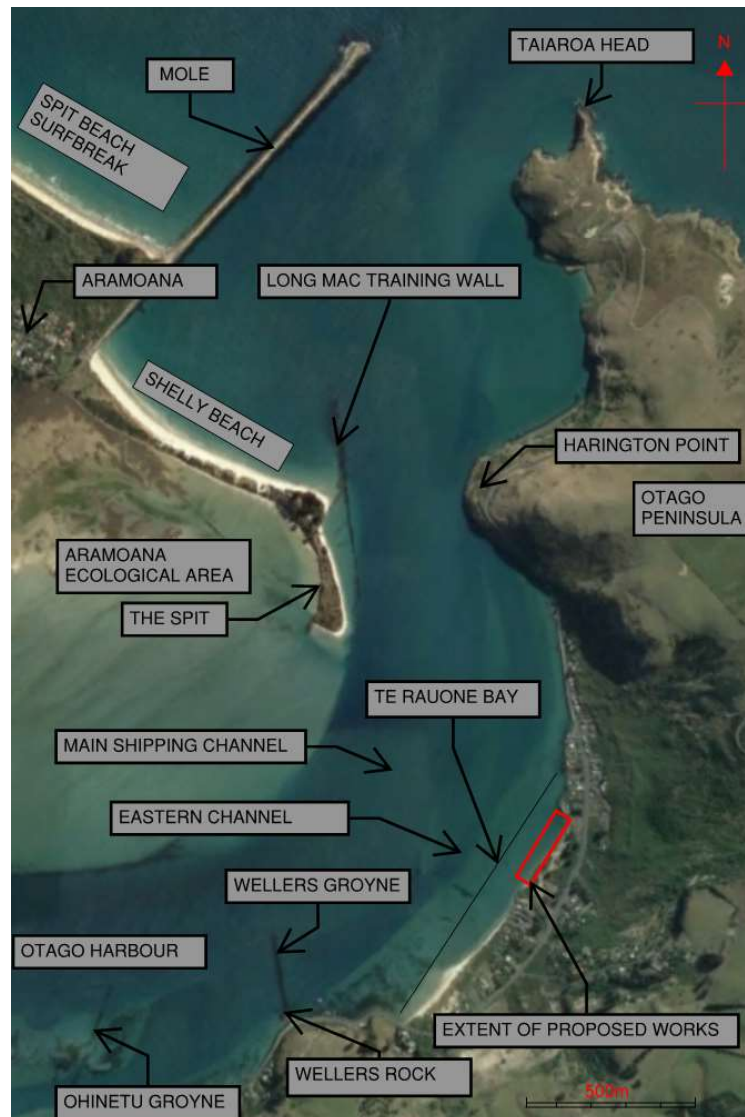


Figure 1 - Location Plan

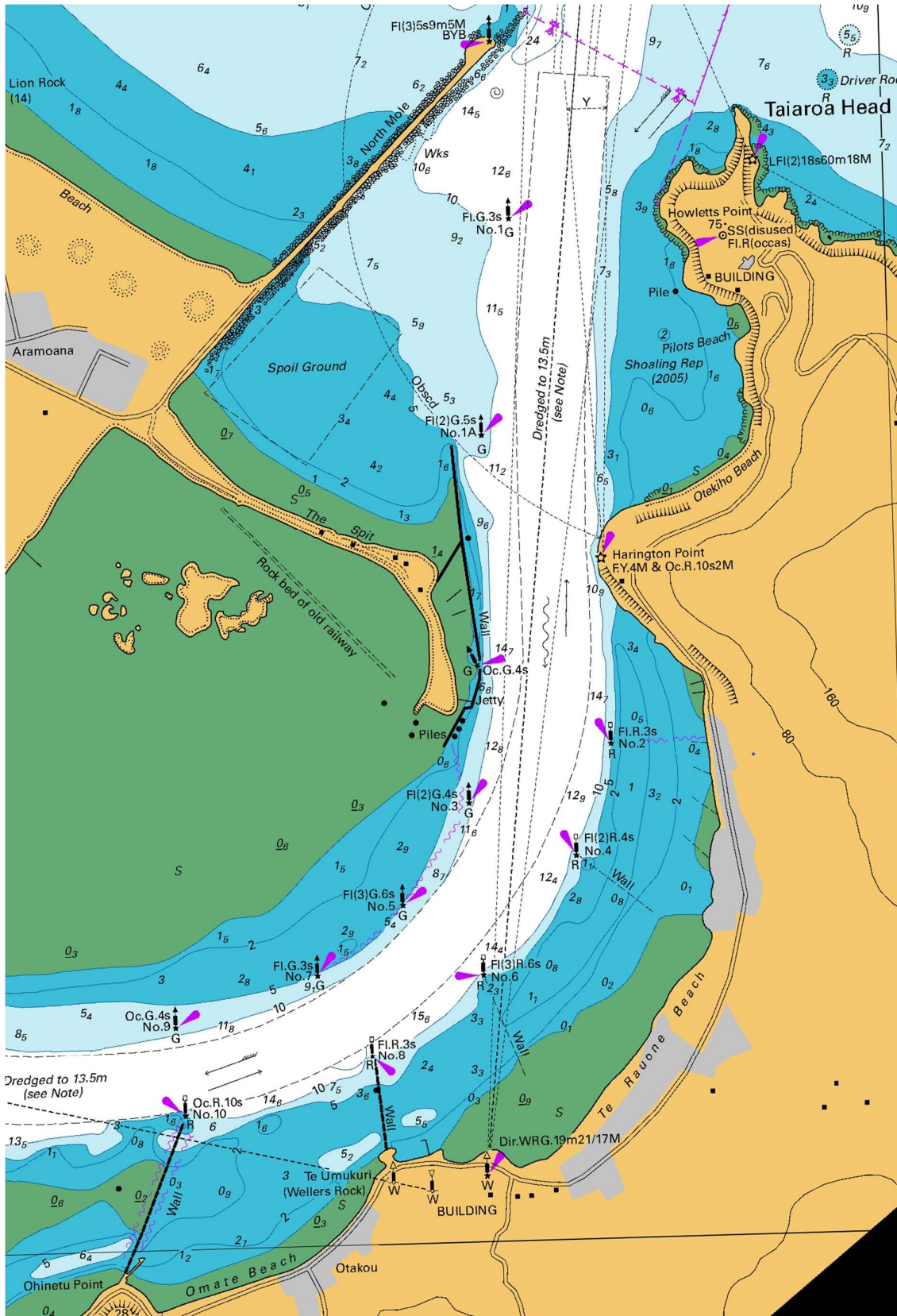


Figure 2 - Bathymetric Features from NZ 6612 Otago Harbour
 (reproduced under Creative Commons Attribution 4.0 International Licence from LINZ)

2 Background and Alternatives

2.1 Background

Te Rauone Beach has a history of sand loss and realignment over the past century, with the northern end retreating landwards while the southern end has accreted, moving seaward – an effective rotation of the beach alignment with apparent transportation of material from north to south, a process which remains evident. This change appears to be associated with modifications to the harbour entrance in the 19th century including the construction of the main entrance mole (the Mole) from Aramoana, the Long Mac training wall on the western side of the main channel opposite Te Rauone and the resulting change to sand supply and the wave climate at the beach (Bakx, 2017). A series of rock groynes/training walls extending to the channel edge were also constructed from the eastern side of the harbour in the late 19th century (Single and Pullar, 2009). A 1930s placement of sand dredged from the harbour channel (Single, 2007; local community commentary, 2016-17) appeared to counter the shoreline retreat for a period of time.

There has been a significant amount of research carried out into the Otago Harbour and entrance, more latterly in relation to investigations related to the channel deepening project. This work includes the compilation of a number of substantial and authoritative reports (Single et al (2010), Bell et al (2009)).

Coastal studies have been undertaken by Otago Regional Council (ORC), POL and Dunedin City Council (DCC) over the past twenty-five years to investigate the sand loss issue at Te Rauone and possible options for mitigation. A concept was developed around 2007-2011 but on detailed review was shelved, and POL initiated a refreshed approach to Te Rauone Beach. A stakeholder meeting with Te Rauone Beach Coast Care Committee (TRBCCC) in August 2016 confirmed that the purpose of any beach works is to create a beach amenity, with a high tide beach width of at least 5m. The meeting also discussed possible options for providing and confining the beach amenity including beach renourishment, with rock groynes perpendicular to the shore, or offshore breakwaters. TRBCCC preferred the beach renourishment approach, in conjunction with perpendicular rock groynes as being more acceptable to the community in terms of visual impact, cultural acceptability and marine access to the beach, and general similarity to the historic harbour training walls.

Following consideration of a number of concepts developed to meet these objectives, an option to improve the amenity of the “reserve beach” comprising beach renourishment with rock groynes to retain the enhanced beach at construction and reduce the potential that the renourishment material may be rapidly transported southwards as evident with the current situation, was agreed as the way forward at a stakeholder meeting in February 2017. The meeting was attended by representatives from ORC, DCC, TRBCCC, POL, coastal geomorphologist Martin Single, and coastal engineers from Beca. It was agreed in principle that construction would be implemented and followed by monitoring of beach behaviour, and potential modification of ongoing maintenance renourishment based on the monitoring results. This approach was preferred by all parties over coastal processes modelling, given the limited scale of the structures and the complexities of the wave climate. This agreed approach has directed the manner in which the design and this coastal assessment has utilised existing studies and information rather than undertaking modelling.

The renourishment and rock groyne option (to be constructed in a single stage) was selected by POL in agreement with the Councils in late 2018, based on consultation with the TRBCCC and the wider public over the preceding year. Feedback from this consultation generally preferred groynes over offshore breakwaters that were considered as an alternative option. This assessment refers to the proposed single stage renourishment and rock groyne scheme as described in Section 3.

2.2 Alternative Options

As described above, options for providing the beach amenity were identified at the outset of the current project in 2016. The options included:

- Renourishment and rock groynes (taken forward to preliminary design).
- Renourishment and shore parallel offshore breakwaters (taken forward to preliminary design).
- Shore parallel headland breakwaters and renourishment
- Renourishment alone
- Modifications to improve the effectiveness of the earlier single breakwater protection proposal
- Do-nothing.

Following discussion with the TRBCCC and consultation with the community, the renourishment and groynes option was selected as the preferred option to be taken to detailed design and consenting. The reasons for selecting this preferred option were:

- Provides high tide beach amenity.
- More acceptable to the community in terms of visual impact compared to the offshore breakwater options.
- Cultural acceptability in that groynes were built on the beach previously and can still be seen in some locations.
- Allows for marine access to the beach.
- General similarity to the historic harbour training walls.
- More straightforward construction.

Of the other options considered

- Renourishment alone will not provide a viable beach amenity as added sand will be quickly transported away from the deposit area at the north and central sections of the beach, requiring frequent maintenance or sand top up. The option was not preferred on this basis.
- Shore-parallel offshore and headland breakwaters were not favoured because of their imposing visual presence, restriction of boating access to the beach, and more difficult construction and maintenance access.
- Options for improvement of the earlier single breakwater option were not considered viable due to the extent of works involved (e.g. 220m long single groyne extending into deeper water and significantly more renourishment material than either the preferred option or the earlier breakwater option). In addition, the resulting scheme was more vulnerable to changes in wave direction as the renourishment material was exposed along the full one-kilometre length of the beach, rather than being compartmentalised into smaller pocket beaches with better protection afforded by three shorter groynes.
- The do-nothing option was not favoured on the basis that it would not provide the beach amenity that is the purpose of the scheme.

3 Proposed Beach Management Scheme

3.1 Proposal Description

The proposal comprises the re-establishment of a sandy beach at the northern end of Te Rauone Beach using sand material recovered as part of the harbour channel dredging programme. The proposal includes the construction of three rock structures to help to protect the deposited sand from the processes that are presently causing erosion of the foreshore, and to confine the deposited sand in place to reduce distribution and loss back to the harbour system or to the south of the scheme. The components of the proposal have been designed in accordance with relevant contemporary coastal engineering methods and technical guidance (Beca, 2020) to create sandy embayments that are consistent with adjacent natural beach slope as established by survey and with the grading of the available sand renourishment material. Similar “crenulate bays” have been constructed around the Waitemata and Manukau Harbours in Auckland. Beach layout, shape, and groyne location have been established in accordance with crenulate bay theory including consideration of the incident local wave climate and tidal characteristics. Rock groynes have been designed to contain the renourishment material, to match the renourished beach profile, to minimise visual impact, and to use rock materials efficiently.

Details of the proposed works, including design approach and technical reference details, are set out in the Detailed Design Report (Beca, 2020) submitted as part of the consent application.

The primary objective of this work is to improve the beach amenity along the reserve frontage, with the application of coastal engineering design principles to establish a beach shape and profile consistent with the natural conditions at the site and available materials. The initial design of the groynes incorporates an allowance for sea level rise of 0.1m in accordance with the current (2017) Ministry for the Environment guidance for a 20-year design life (to 2040).

Over time, the actual profile of the beaches will vary from the design profile as it is acted on by wave events, vessel wake, and tides, with potential for minor steepening at the northern, curved end of the beaches. Storm events may result in flattening of the beach slope and removal of material offshore, and subsequently downcoast to the south. Onshore wind conditions have the potential to carry sand landward from the beach onto the reserve, where it will be trapped by the existing vegetation. This windblown sand remains part of the overall system, contributing to any dune created as part of the future reserve upgrade. Sand from the renourished beaches that is removed offshore or blown landward will be replaced by material recycled from the accreting area south of the site (subject to monitoring indicating the appropriateness of this), and by renourishment using sand from channel dredging or similar sources of suitable grain size and quality. Beach monitoring will be used to assess the frequency and volume of recycling and renourishment.

3.2 Rock Structures

The rock groynes will extend 70 - 80m from the existing shoreline to just below normal low tide mark. This extent is required to adequately contain the designed beach profile and is well inshore of the historic groynes/training walls installed to train the shipping channel. The proposed groynes comprise a layer of armour rock over small “underlayer” rock. Geotextile is laid beneath and through the groynes to limit movement of sand through the groynes.

The inshore end of the northern groyne will abut an existing rock revetment that provides shoreline protection to areas adjacent to the reserve. This inshore end of the groyne will be constructed to provide a degree of structural connection to the existing revetment. The central groyne, which is required to maintain the required beach width between the two outer groynes, ends at the shoreline, with a sandy “walk through” access between the groyne and the existing backshore. The southern groyne will abut the sandy scarp on the shoreline adjacent to the existing section of rock revetment located to the south of the site. The southern

groyne is designed without geotextile through the groyne, to allow limited movement of sand through the groyne, feeding the beach south of the site.

3.3 Beach Renourishment

Following the completion of construction of the rock groyne components, the intermediate compartments formed will be filled with sand recovered by dredging from the navigation channel, and the surface graded to approximate the design shape. Based on a 2017 survey of the beach, the in-place volume of sand renourishment required is 19,000 m³, with a further allowance of 15,000m³ proposed to compensate for ongoing erosion between 2017 and construction. Sand will also be placed immediately south of the southern groyne to reduce downcoast effects. Ongoing monitoring will be undertaken to programme further input and redistribution of sand required as the beach establishes its natural profile and rates of exchange with the southern beach and offshore area, as well as potential landward movement of windblown sand (refer to Section 3.1).

The beach slope is based on the grain size of material typically available from the outer channel dredging, which is clean (free of fine silty materials) locally sourced material of similar origin to the existing native beach and thus compatible with the beach area.

3.4 Construction Procedures

The construction procedure developed for the completion of the works has been developed based on the concept presented, appropriate sources of materials, and practical methods of transportation and installation of the components to meet the design specifications. The construction sequence requires that the groynes are constructed initially to provide containment of the sand beach material as it is delivered to the beach. Details of the on-site rock handling and placement for groyne construction will be refined by the installation contractor to suit its specific installation procedure and plant capability, but general requirements are presented here for information. Rock groyne and onshore construction will be carried out under contract with a contractor to be appointed. Construction procedures outlined below present the general approach and requirements for construction of these components which may be modified to suit the contractor's equipment, local knowledge, and expertise. Sand recovery, conveyance and delivery to the beach will be undertaken by POL. It is intended that the rock groyne construction contractor will also provide the onshore components of the beach renourishment process in conjunction with the POL sand supply.

3.4.1 Contractor's Site

A contractor's site establishment and storage area will be required. The temporary establishment and storage area is expected to be located on an adjacent private property. Site offices, plant, materials and staff parking will be located in this area.

Temporary vehicle access to the beach, the groynes and the contractor's site establishment area will be established and maintained over the construction period. The temporary accessways are expected to comprise a running course of clean AP65 aggregate (approximately 1500m² area and 300m³ in situ volume) placed over geogrid/geofabric, with minor grading of the sandy backshore at the beach accesses to provide a smooth transition between land and beach (up to 400m² area and 300m³ in situ volume of grading).

During the construction period, access to the beach and foreshore, site establishment area and site accessways will temporarily be restricted to the contractor, in order to safeguard the public and the contractor's staff. This will be achieved using temporary site fencing and signage. The general layout of the temporary construction areas and access are indicated in Beca Drawing 3331121-SK-002, included in Appendix B.

A construction environmental management plan (CEMP) including temporary construction area and access details will be provided to the consenting authorities for information prior to construction, and implemented and maintained during construction.

3.4.2 Rock Groyne Construction

Rock of suitable durability and grading to meet the requirements of the design specification is expected to be provided from a local Dunedin quarry for groyne construction. It will be transported by road to the Te Rauone Reserve where it will be delivered directly to the beach for incorporation into the works or temporarily stockpiled. Stockpiling will be limited to an identified location within the contractor's site establishment area, with construction management anticipated to require minimal and managed stockpiling. A temporary traffic management plan will be in place for construction traffic.

Groyne construction may be land-based, with temporary rock or sand access bunds extending seaward from the shoreline for groyne construction, or marine-based using barges and workboats, or a combination of these. Off-road plant will be required to work on the beach as tide permits and is expected to include loaders/dozers and off-road trucks to load and transport materials, and excavators to undertake the limited excavation (e.g. for groyne toe), and geotextile and rock placement.

It is anticipated that the contractor will construct the groynes progressively in sections as follows:

- Excavate toe trenches, place geotextile on existing seabed/beach and cover with rock underlayer.
- Place rock underlayer to form centre of groyne, place geotextile through centre of groyne.
- Place rock armour over rock underlayer and geotextile to form finished groyne profile.

The northern groyne will connect to an existing northern revetment (refer to Section 4.1). The connection works, including localised revetment reconstruction, will be directed on site by a senior marine engineer. The general approach is expected to include:

- Existing large rock elements will be removed from the mid/upper revetment.
- The revetment face will be shaped to a regular 1:2 slope with the addition of new underlayer rock.
- The landward end of the new groyne will be placed against the revetment face.
- New armour rock and existing large rock will be placed on groyne and revetment at the connection to give an interlocked finish with a 1:2 slope, transitioning into the existing revetment on both sides of the groyne.

These works together with safety, monitoring and management measures, provide a pragmatic approach to installing the northern groyne, consistent with typical industry practice.

The contractor will be required to establish an approved Construction Management Plan (CMP) detailing the work procedure which will provide for the sequential construction of the groynes from north to south. The CMP will require description of the overall approach to construction, and the step by step processes to control the extent of toe excavation, geotextile placement and rock placement that can be achieved in each tide cycle.

The total duration of rock groyne construction work is estimated to take in the order of 11-14 weeks, considering the tidal working and rock supply and placement rates.

3.4.3 Beach Renourishment

The beach is proposed to be re-nourished with sand dredged from the shipping channel. The sand will be sourced from the navigation channel "Main Claim" area, where sand has a suitable grain size (similar to that found on Te Rauone Beach) and is naturally clean. The indicative location of the proposed sand source and arrangement for sand recovery and delivery is shown on POL drawing A3.11863 included in Appendix B.

Equipment to be used

The backhoe dredge, Takutai, will be utilised as a platform to recover sand and pump it ashore. It will sit on its spuds (piles lowered and raised to position the dredge) on the port side of the navigation channel. It will also have anchors deployed (by the work boat Kapu) with marker buoys. Takutai will be on site 5-6 days a week and will establish on site on a slack high water.



Figure 3: The dredger Takutai. Note that she will be fitted with a suction head, not an excavator bucket, for sand recovery.

Dredging Method

A submersible dredge pump will be mounted on the boom of the Takutai, replacing the excavator bucket (Figure 3). On board dredging software will be used to locate the pump within the dredge claim and define the dredging depth. The sand production head fluidises the sand material on the sea floor with water jet assistance before the dredge pump recovers the sand slurry and pumps it to shore.

Sand Delivery Methods

There are two possible methods for depositing the sand material from the dredge and onto the beach at Te Rauone. The most appropriate method will be determined depending on the profile of the beach at the time of the works and the level of containment the sand requires as result of that beach profile. Each method is outlined below.

A 150 mm diameter polyethylene flexible hose (approximately 500 m in length) will be buoyed and anchored, and run from the Takutai to the shore. A sand/sea water slurry mix will be pumped through this pipeline. The discharge end of the pipe will be fixed with waratahs allowing the sand/water mix to be discharged onto the beach below the Mean High-Water Springs (MHWS) mark. The seawater will run back into the harbour leaving the sand to remain on the beach creating a delta effect. When sufficient sand has been deposited, the discharge end of the pipe will be moved along the beach and re-secured with the waratahs and a new delta created. Using this method, a series of overlapping deltas will raise the level of sand on the beach. The natural fall of the beach will ensure distribution of the sand pumped ashore, with final levels achieved by use of machinery (light wheeled diggers or dozers). This method is known as the delta model.

An alternative method that may be employed is the bund model. In this case, sand will be pumped from the Takutai to shore via a flexible hose into banded settling areas prepared along the beach face. The settling areas will have an overflow to allow the excess water to run back down the beach allowing the sand to settle. A grid pattern would be set up along the beach and when a banded area is filled, the hose will then be moved to the next banded area. The bund walls would be made of beach sand. After settlement of the sand, it would then be spread by machinery along the beach to achieve final levels.

Production rates of sand delivery will be dependent on the setup and securing of the pumped delivery lines, the efficiency of pumping system, and the control of the dredger. The works will also be subject to a number of constraints (breakdowns, shipping, poor weather, low productivity, etc) it is expected that the delivery of required sand volume required to establish the design profile could take approximately 10 to 14 weeks to complete.

Land-based Beach Renourishment

Some land-based re-nourishment may be placed to provide a base of sand prior to the marine-based beach nourishment being undertaken. This could involve approximately 1200 cubic metres of sand. The sand would be brought ashore at Dunedin City Wharf and then trucks would be used to transport it to site via Portobello and Harington Point Roads.

The sand supplied in this manner for any land-based renourishment would be placed above the MHWS line in the beach berm location, and would help establish the berm and new MHWS line which has retreated considerably over recent times.

Overall Construction Period and Disestablishment

Construction is expected to take some six to eight months to complete, depending on weather and marine conditions, downtime, etc. Disestablishment, including removal of temporary vehicle access, site offices, plant and any surplus materials, and reinstatement of the contractor's site area, will be completed at the end of construction.

3.4.4 Future Beach Maintenance

It is anticipated that in the years following the completion of the works additional sand may be required to replace the sand lost through ongoing natural processes. This will be determined by beach monitoring with sand being relocated within the embayments, potentially recycled from the accreting southern end of the beach, and new sand added to the beach from channel dredging. Recycling of sand would involve the redistributing of sand along the beach using grading machinery and potentially trucks if needed, while sand dredged from the channel would be distributed using the marine-based re-nourishment methods outlined above.

This future beach maintenance will be determined by beach monitoring and might involve relocation and/or recycling of sand on a 2-5 yearly basis with new sand being required possibly around every 5-10 years.

4 Existing Coastal Environment

4.1 Setting

The site of the works is on the eastern side of the Otago Harbour entrance channel between Wellers Rock to the south and Harington Point to the north (refer to Figure 1). The Te Rauone Beach shoreline runs approximately northeast-southwest. There is approximately 800m length of sandy beach between extensive sections of continuous rock revetment to the north and south. The beach is divided by a 100m section of rock revetment protecting private property into two sections, 250m to the north and 450m to the south. The northern section has a history of erosion and continues to retreat, and is the site of the proposed beach management scheme. The southern section has accreted significantly (48m over the past 20 years).

The sandy section of Te Rauone Beach lies landward (east) of a flat subtidal sandbank (water depths approximately -0.6m CD to +0.2m CD) 150 to 200m wide which is inshore of a secondary eastern channel. Opposite Te Rauone Beach, the main harbour channel is about 200m wide at charted depth, 400m wide to the tops of the banks with the centre about 600m offshore. The eastern channel midpoint is about 250m offshore. There are remnants of several historic groynes in the nearshore off Te Rauone Beach (Single, 2007), two offshore of the southern sandy Te Rauone Beach foreshore, and all partially buried. Two more substantial groynes to the south-west, at Wellers Rock and Ohinetu Point, extend from the shoreline to the edge of the navigation channel. These structures remain clearly visible in aerial photos. They were constructed starting in the early 1900s as part of works to improve the channel navigability and train the main shipping channel away from the eastern shore.

Harbour entrance stabilisation works were undertaken between 1884 and 1940 (Bakx, 2017) including the construction of the Mole, the construction and subsequent raising of the Long Mac training wall, and associated groynes on the western side of the channel opposite Te Rauone. These historic changes improved water depths and stability of the harbour entrance channel and modified the natural coastal processes and sediment transport.

Harbour entrance training walls (the Mole, Long Mac) and training walls within the harbour (e.g. the Kaik) were constructed between 1884 and 1909. These included nine “sand screens” and three training walls constructed between 1905 and 1909 at Te Rauone Beach. These latter works appear to have been constructed to attempt to confine the main channel to its present location north west of the beach, and to reduce flows through the original eastern channel. In addition, some 1.5 million hopper yards of dredged sand were placed in the eastern channel in the early 1930s.

The effects of these modifications include the establishment over time of a self-scouring entrance to the harbour (currently at 13.5m) compared to the previous shallow bar (4.0 to 5.5m). This allows the entry of larger swell waves to the harbour although through a more confined entrance. It has also reduced the volume of sand that is able to enter the harbour from the outer coastline because of the physical presence of the historic stabilisation works, and the deeper entrance and confined flow path.

In addition to the harbour training works, the eastern side of the harbour has progressively been protected by long sections of continuous rock revetment since the early 1900s. Rock revetments protect Harington Point Rd and private properties to the north and south of Te Rauone Beach. An isolated section of rock revetment approximately 100m long is located in the centre of Te Rauone Beach, protecting property immediately south of the reserve. These revetments prevent access to shoreline sediment supply to the coastal processes, and reflect wave energy promoting the scour and transport of nearshore sediment.

As much as the harbour modifications have affected local coastal processes at Te Rauone, they also tend to compartmentalise those processes. Effects on the sandy foreshore at Te Rauone Beach are confined between sections of rock protected coastline to either side, and the shipping channel, where strong currents and deep water provide an effective outer boundary to the local compartment. Sediment may be lost across

this boundary, but is unlikely to be recovered or supplied from this channel area. Similarly, localised changes to wave and current conditions will not affect other harbour areas either alongshore or on the opposite side of the harbour.

Outside the harbour entrance, and to the west of the Mole, Aramoana Beach (also known as Spit Beach) is a recognised surf break of regional and national significance and is protected under the New Zealand Coastal Policy Statement (2010). The surf at this location is generated by open ocean swells, and is independent of any changes that could be imposed at Te Rauone.

4.2 Te Rauone Beach Hydrodynamics (tides and currents)

The site experiences semi-diurnal tides with a tidal range of approximately 2m (refer to Table 1 for tides at Spit Wharf, the nearest tidal station to Te Rauone Beach). The tidal prism of the Otago Harbour (the amount of water flowing in during a tidal cycle) is between $6.9 \times 10^7 \text{m}^3$ and $7.5 \times 10^7 \text{m}^3$ (Quinn 1979, Royds Garden 1990).

Table 1 - Spit Wharf tide levels (LINZ)

| Tide Level | Elevation above Chart Datum (m) |
|-------------------------|---------------------------------|
| Mean High Water Springs | 2.00 |
| Mean High Water Neaps | 1.70 |
| Mean Sea Level | 1.00 |
| Mean Low Water Neaps | 0.40 |
| Mean Low Water Springs | 0.10 |

Tidal currents within the Te Rauone Beach area recorded 260m from shore have maximum speeds in the vicinity of the eastern channel of between 20 and 30cm/s (Mulgor 2007) and are aligned parallel to the beach and to the eastern channel that lies between the shore and the main harbour channel. These currents are much smaller in magnitude than in the main channel which reach a maximum of 155cm/s between Harington Point and Spit Jetty on the flood tide, and continue to reduce in magnitude closer to the shore as illustrated in Figure 4 which compares the peak flood tide current vector distribution. By inspection, the nearshore tidal currents in the vicinity of the proposed beach management works at peak flow are nominal only (<10cm/s).

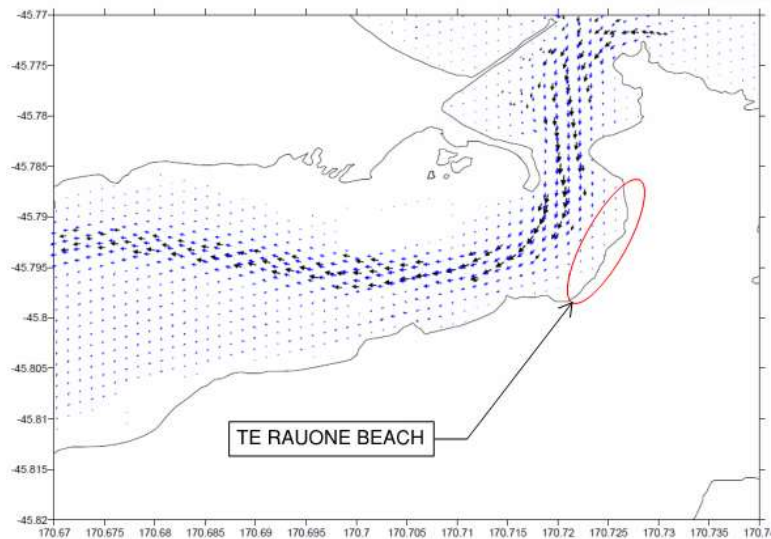


Figure 4 – Comparison of measured current vectors (black) with hydrodynamic model currents (blue) at peak flood tide (Bell et al, 2009)

4.3 Wind

The site is subject to prevailing south-westerly and north to north-easterly winds (Bell et al, 2009) as shown in Figure 5. The winds from the south-westerly quadrant are strongest with 99 percentile speeds to 24m/s compared to those from the north-easterly to 16m/s. These winds have the capacity to generate moderate waves within the harbour, as discussed in the next section.

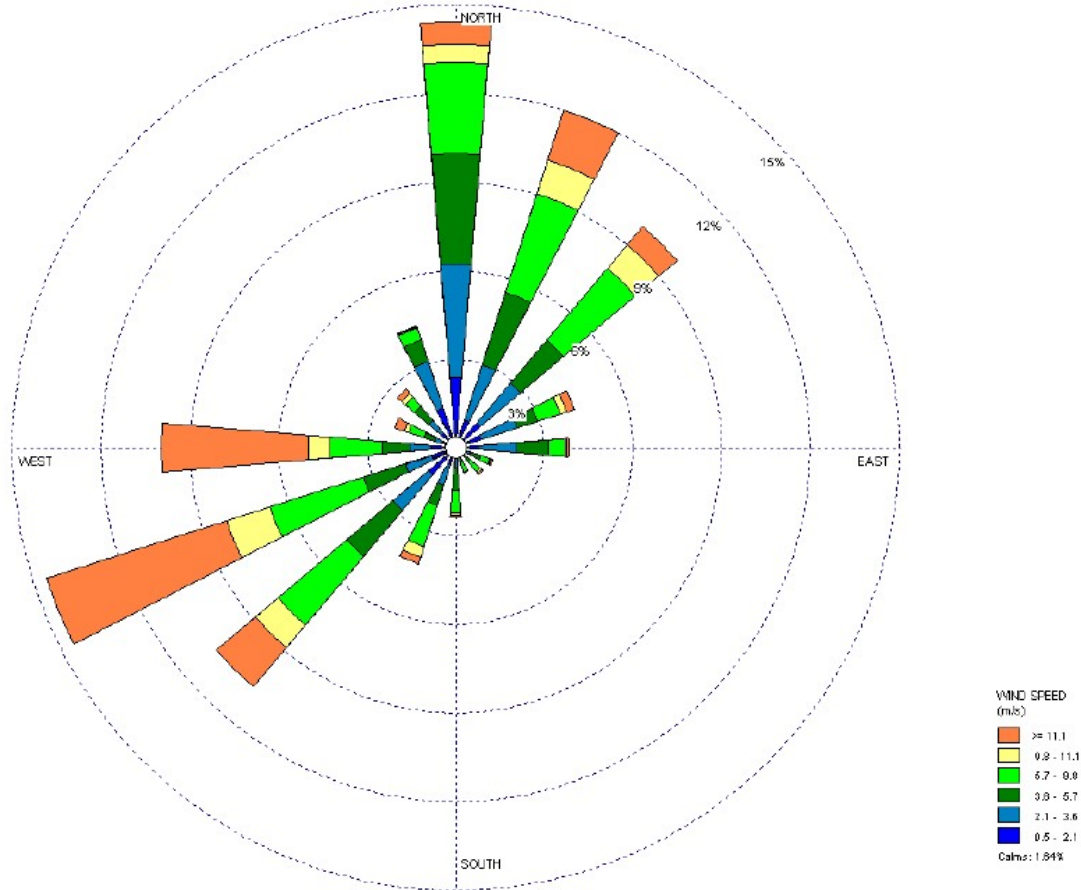


Figure 5 - Tairaoa Head wind rose for May 2003-May 2008 (from Bell et al, 2009)

4.4 Waves and Surge

Wind waves generated within Otago Harbour are fetch limited, with fetches varying with tide level. Wave modelling (Bell et al 2009) shows significant wave heights generated by westerly winds in the navigation channel at Harington Bend can reach 1.2m, and periods are generally in the range of 2 to 5 seconds. Te Rauone Beach is protected to a degree from these as a result of shoaling and refraction across the near shore shelf, as indicated in Figure 6 below that shows the distribution of wave heights generated by westerly winds. Local observations suggest that the most notable erosion events observed at the northern end of Te Rauone Beach occur under wind waves from this general direction, and the model suggests greater exposure at the northern end of the beach than the southern, where sand build-up is evident.

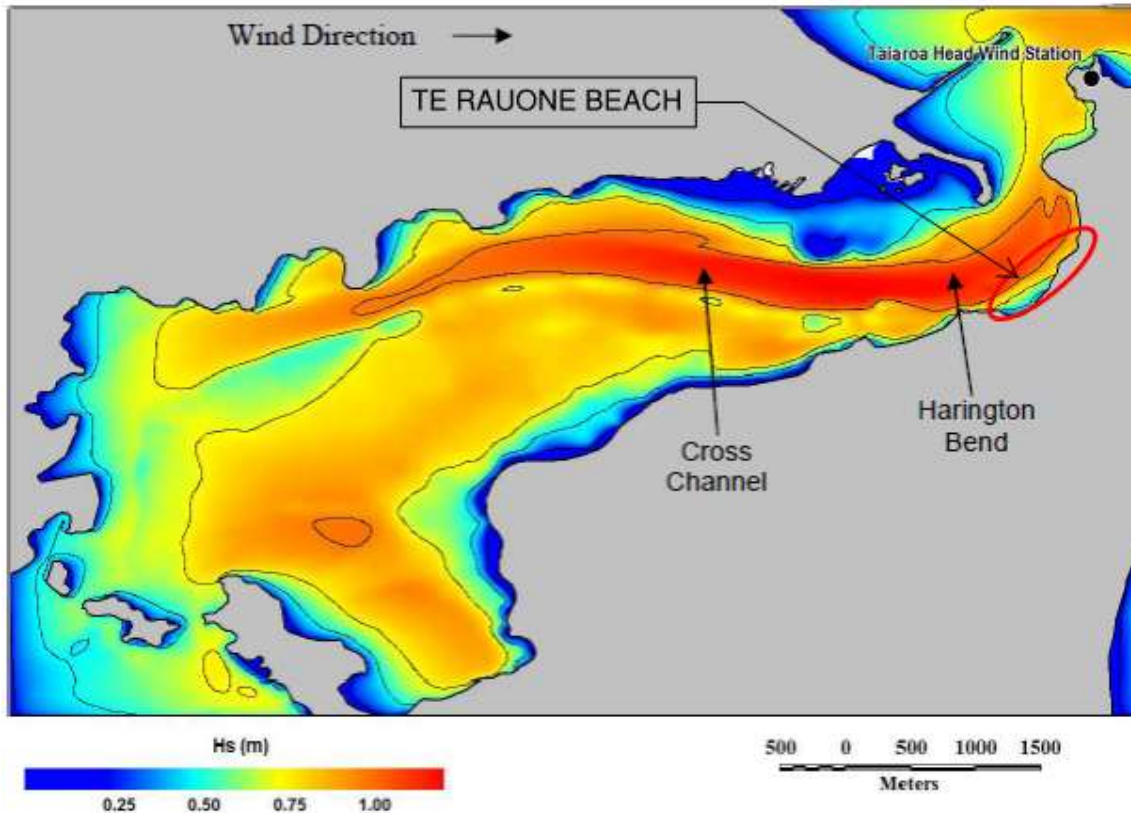


Figure 6 – Wind-generated significant wave heights from the 99th percentile westerly winds (Bell et al 2009)

Waves generated locally by northerly winds also reach the site but are significantly smaller, consistent with the smaller wind speeds and shorter fetch length available to the Mole. Penetration through the harbour entrance of longer period northerly swell waves adds to this exposure and would be consistent with the observation that sand that is lost from the northern end of Te Rauone Beach appears to be transported to the south end of the beach which is less exposed to swell remnants, and is accumulating there.

Ship wake has also been identified as a potential contributor to erosion of the Te Rauone foreshore. Observation and measurement of wake effects (Single and Pullar 2009, and Goring 2008) concluded there is strong correlation between the occurrence of surge (long period waves) and ship passage, with observed wave heights of up to 0.35m and periods of greater than 25 seconds. This surge is capable of mobilising seabed sediments and bedload transport on the low tide shelf at Te Rauone, and at the base of the dunes at high tide. Overall however it was concluded (Single et al, 2009) that “The cumulative effect of vessel wake, both current and in the future, is likely to be much less than the effects of natural waves and tidal currents occurring in the dynamic environment of Otago Harbour.”

4.5 Shoreline Change and Sediment Transport Processes

Previous studies have investigated the sediment processes and erosion in the Te Rauone Beach area. Recent survey work (2019) undertaken for POL recording dune toe and vegetation line been added to records of similar surveys of Te Rauone Beach at intervals since 1950. The accumulated indicative shoreline positions are plotted on Beca Drawing 3331121-SK-001 included in Appendix B. This drawing shows the regular and marked foreshore retreat along the northern shoreline in front of the reserve, with regular and marked advance of the southern shoreline towards the Wellers Rock end of the beach. POL drawing A3.11863, also included in Appendix B, shows the proposed development superimposed on the

2007 aerial photograph, illustrating the extent of shoreline changes since that time. Retreat rates over the last 5 years at the reserve have been 3.8m/year compared to 2.5m/year for the 10 years before 2014. The increase in rate of retreat has occurred as the last of a number of large trees have been lost to the tide, and with no effective foredune remaining, the northern end of the Beach in particular is vulnerable to further retreat. Accretion at the south end of Te Rauone Beach shows a similar pattern with continued advance of the foreshore. The accretion is distributed over a greater length of beach frontage, and by inspection of the changes shown by the survey results, sediment processes appear to be transferring sand from the northern part of the beach to the southern end of Te Rauone Beach.

Several investigations have included comment on the erosion process and potential causes, although specific conclusions have not been established, rather that a range of historic and present-day effects and interventions to the coastal environment have created a complex and indeterminate situation. Modifications to the harbour entrance and navigation channel have significantly changed aspects of the harbour characteristics. The historic changes to the harbour and channel described in Section 4.1, and changes to potential sediment supply from onshore sources including the original (pre-1900s) dune field at Te Rauone, have affected the equilibrium of sediment transport processes. Te Rauone Beach continues to adjust to these drivers. The general interpretation of the studies to date is that Te Rauone Beach no longer receives any significant sediment input and the northern section of the beach has experienced retreat for over 100 years.

4.6 Summary of Coastal Environment

Te Rauone Beach is subject to long term sediment processes (> 100 years) which appear to be removing sand from the north end of the beach, and accumulating it at the south end. The beach at Te Rauone is a relatively benign site in terms of coastal exposure. The tidal range is moderate. Tidal currents within the bay are reported as shore parallel and up to 30cm/s 260m offshore, and reduce further closer to the shore in the vicinity of the beach. 600m off the beach, currents in the shipping channel are much stronger, reaching 155cm/s (Bell et al).

Waves observed at Te Rauone Beach are predominantly locally wind generated, although the sediment movement on the beach from north to south suggests that refracted longer period swell waves reach Te Rauone through the harbour entrance. Surge action developed by ship wake occurs with the passage of large vessels and this resulting long period wave action may be contributing to the erosion at Te Rauone Beach (Goring 2007, Bakx 2014).

Modifications to the harbour in terms of dredging and rock training works appear to have modified the supply of sediment available to the beach, and the processes that have historically distributed sediment within the harbour. The construction of rock armouring to sections of the shoreline also limits the supply of sediment from those areas. The erosion at Te Rauone is caused by natural processes acting in combination with these historic and more recent changes.

5 Assessment of Coastal Effects of the Proposed Works

5.1 Intended Performance of Proposed Works

The intention of the proposed works is the improved amenity of a section of Te Rauone Beach by increasing the volume of sand on the beach to include an upper berm above high tide level, building out from the current erosion scarp line to allow all tide enjoyment of the beach. The process of establishing this berm to a sustainable beach profile with the sand material available will require the addition of an adequate volume of sand to create a more evenly sloping beach face from berm level to low water that is better equipped to dissipate wave energy and protect the current scarp line. This change provides the ability to improve energy dissipation on the beach face compared to the present situation where wave energy is reflected at higher tide levels by the steep upper beach and scarp toe, and combined with the potential to maintain a sand buffer in the upper berm, the renourishment component of the design component can be categorised as a soft option in terms of coastal protection at this site.

The rock groynes proposed are necessary to confine the added sand material and prevent it being moved rapidly along the shore to the southern end of the beach. The groyne arrangement has been designed using crenulate bay theory, providing “control points” which refract the incoming waves and anchor the renourished embayments. The shape of the renourished shoreline is created by the arrangement of these groynes, particularly the north and central groynes. The southern groyne will confine sand in the southern end of the renourished section, and has been designed to provide a degree of porosity to allow sand to pass through and thus retain the potential for the existing north to south transport towards the southern end of the beach. The initial placement of sand to the south side of this groyne as part of the renourishment process is intended to help support this process.

The crest height of the rock groynes has been determined considering the renourished beach profile, efficient use of rock and visual impact. The groyne crest level at the landward end is 0.5m above the renourished beach profile to provide containment of the renourishment material. The crest level at the seaward end of the groynes is set at Mean Sea Level (MSL) to reduce the visual impact of the groynes. Marker poles will be installed at the outer end of each groyne for guidance for small boats approaching the beach.

5.2 Effects on Hydrodynamics (tides and currents)

The proposed works have been designed to provide restoration of a usable beach crest which will by its nature move the high tide mark and corresponding lower intertidal beach face seaward of its present positions. As the overlay of the scheme components compared to historic shorelines plotted in Appendix B shows, the main extent of the toe of the northern beach compartment lies inshore of the 1970s and 1980s shoreline positions i.e. the new shorelines are inshore of historical shoreline positions.

The proposed beach management scheme marginally (0.4%) reduces the total cross-sectional area of the harbour at Mean Sea Level and is located in an area of low currents. As noted above, the area is also largely inshore of the historical shoreline. The proposed scheme will have no effect on harbour tide levels, as tide levels are driven by major global processes and the changes in cross sectional area are negligibly small. Similarly, the effects on tidal currents in the main channel and eastern channel are therefore expected to be negligible. There will be minor, localised current effects at mid-tide at the site, with the low velocity currents deflected around the groynes. Any localised increase in current velocity would be difficult to discern in practice because of the negligible reduction in cross sectional area and the low velocity of the existing currents. It is expected that effects at low and high tide, when currents are minimal, will be negligible. Overall, the effects on tides and currents are considered to be less than minor.

5.3 Effects on Wind

The development is not expected to have any effect on the overall wind climate, although there may be a minimal level of localised sheltering of nearby beach areas in the lee of the northern and southern groynes under the relevant wind conditions. This level of effect is considered negligible.

5.4 Effects on Waves and Surge

The effect of the proposed beach management works on the wave climate at Te Rauone Beach will be to reduce the exposure of the shoreline in the immediate vicinity of the works to waves and vessel wake (surge).

As explained in Section 5.1, the groynes have been designed to refract incoming waves as well as providing a physical barrier to wave attack. In this way, they protect the renourished embayments between them from swell waves that enter the harbour and from harbour wind waves, as well as helping to provide protection to the beach from wake effects from incoming vessels.

The groynes have also been designed as placed rock structures with relatively mild side slopes (1:1.75) and voids between the rock units to improve dissipation of wave energy and reduce wave reflection. The renourished embayments between the groynes will also help to dissipate wave energy at the shoreline, as described in Section 5.1.

The effect of the proposed works on the wave climate at Te Rauone Beach is therefore to reduce wave heights at the shoreline, leading to less mobilisation and loss of beach sediment from the foreshore at the site - a moderate, localised, beneficial effect. The groynes may result in minor, localised wave reflection and refraction in the immediate vicinity of the groynes and Te Rauone Beach under certain wave conditions (waves approaching the structures at close to perpendicular angles i.e. northerly waves for the northern groyne). The reflection effects are partly mitigated by the groyne design i.e. the relatively mild side slopes and voids between the rock units. The refraction effects are part of the desired project outcome of sheltering the beach from wave action and creating crenulate bay shapes.

There is not expected to be any significant effect on waves in the harbour beyond the immediate vicinity of Te Rauone Beach. Wake from large vessels at normal operating speeds may be reflected towards the channel but should not have an effect on adjacent shores, the harbour bed or channel edge geomorphology. Energy transferred by vessel wake will be dissipated in part by its initial travel across the shallow nearshore shelf off Te Rauone Beach, and then by the restored sandy beach slope. Wake energy impinging on the rock groyne components will be reduced by the porous nature of the rock structures and the geometry of the flat sloping outer roundheads. The inshore sections of the groynes will be limited in exposure by the sand renourishment, with the design levels established to provide 0.5m of exposed rock above the finished beach level. The northern side of the northern breakwater where water depth will not be reduced by the addition of sand is the only exception to this situation, and the porosity and lower crest height of the northern groyne structure will ensure it will be less reflective than the extensive impermeable and steeper armouring that already exists around the harbour edge to the north.

Overall, any adverse effect on waves is expected to be minor and limited to the vicinity of the groynes and Te Rauone Beach.

5.5 Effects on Shoreline Change and Sediment Processes

The main objective of the Te Rauone Beach Management Scheme is to establish a section of restored beach providing recreational amenity. The concept devised to achieve this requires the addition of an adequate volume of sand to create a healthy beach profile with an appropriate slope and sand buffer to allow the beach to respond naturally to wave exposure and to dissipate wave energy. The effects of this

component on shoreline and sediment processes will be to provide a “soft” dissipative feature for wave energy along the reserve frontage, with the provision to allow some of the sand provided by renourishment to be supplied through the southern groyne to the southern section of Te Rauone Beach. This process is presently occurring with material being eroded from the Beach.

The rock groyne components have been designed to retain the added beach sand in position, with careful consideration to the minimisation of effects on adjacent areas of foreshore. Transport rates for sediment from the lower harbour north of Te Rauone Beach are minimal, and the northern groyne will not affect supply of this material. The northern groyne will assist in maintaining the new beach by reducing the exposure to wave energy from the north-east, translated wave energy derived from the rock-faced shoreline to the north, and vessel wake. The southern groyne will be constructed to allow sand to pass through it to the south to continue the existing sediment transport process, and will be assisted in this process by the initial (and on-going) placement of sand on the south side of it to address the potential for localised erosion downcoast of the groyne. This southward movement of sand, as with the present situation, has the potential to cause accretion at Wellers Rock Jetty. This will be monitored by surveys of water depths at Wellers Rock Jetty and beach profiles at the southern end of Te Rauone Beach.

The proposed works will have an effect on sediment processes and the shoreline at Te Rauone Beach – the purpose of the scheme is to improve the existing situation. The scheme is designed to reduce the loss of sand from the northern end of Te Rauone Beach while mitigating downcoast effects, which might potentially cause erosion south of the southern groyne, as described above. The scheme includes beach monitoring to confirm maintenance arrangements and maintenance of the renourishment areas. Maintenance is expected to include relocation of sand within each embayment, recycling of sand from the accreting areas south of the site (subject to monitoring confirmation), and future renourishment using sand from channel dredging or similar. The scheme is designed to minimise effects, limiting them to the immediate vicinity of Te Rauone Beach. Overall, the effect of the scheme on sediment processes and shoreline change is considered to be minor in the context of:

- the negligible effects on the wider harbour (see below),
- the beneficial effect on the northern section of the beach, and
- the proposed ongoing mitigation (i.e. inclusion of features to minimise adverse effects) and monitoring.

5.6 Effects on General Harbour and Surf Break Conditions

The proposed works are confined to a small portion of the foreshore of Te Rauone Beach. They sit inshore of a shallow subtidal flat area some 600m wide and incorporating a relatively shallow eastern channel. The main shipping channel (maintained to more than 13.5m navigable depth, and carrying most of the tidal exchange flow to the harbour, with significantly higher currents) lies beyond this. This channel and the rock-faced shoreline to the north and south of the bay provide effective boundaries to natural sediment transport processes, where little transportation takes place into or out of the Te Rauone coastal compartment. This compartment is subjected to externally generated waves which are dissipated on the stretch of sandy foreshore and not translated to other parts of the harbour. Tidal currents of much lower magnitude than those in the shipping channel flow through the compartment reducing in magnitude towards the shore. The footprint of the restored beach is generally within the extent of recent previous shorelines and will not significantly modify these current patterns. The small magnitude of the coastal change proposed will not have any effect on general harbour processes or the Aramoana Ecological Area and Shelly Beach which are distant and across the deep harbour channel which provides the outer boundary of the Te Rauone coastal compartment.

For the same reasons, and being further isolated by the Long Mac and the Mole, the proposed works will have no effects on the Aramoana surf break.

5.7 Coastal Effects of Construction Procedures

Construction procedures as outlined will have temporary effects on the reserve frontage at Te Rauone.

These effects include:

- Occupation during the construction period of the northern section of Te Rauone Beach, part of the reserve and part of an adjoining private property by the contractor. The resident's agreement to this has been obtained (refer to overarching Assessment of Environmental Effects).
- Establishment and maintenance of construction vehicle access to the beach.
 - This will be temporary and fully restored on completion. There is low potential for release of fines. Clean aggregate will be used for the temporary accessways, which are laid on existing ground with no earthworks. The minor grading at the beach accesses is in the existing sandy backshore material, which allows for rapid infiltration of rainwater, limiting runoff.
- Operation of construction machinery on the beach
 - This will create temporary disturbance of the beach surface by vehicle tracks and excavation for toe establishment around the groyne perimeter. These changes are likely to be restored naturally over subsequent tidal cycles.
- Minor adjustments to existing rock protection at the northern end of the beach to ensure that the northern groyne provides continuous structural integrity at the junction point.
 - This will require careful supervision to ensure that sound transitions are established.
- The potential for release of fine sediment to the harbour is present through the delivery of sand recovered from the main channel bed containing finer fractions to the beach, or the delivery process not allowing adequate time for the sand to settle on the beach and flowing back to the water. Studies for the investigation of the Next Generation dredging project (Single et al, 2009) included sediment plume modelling, and on the basis of the sediment material at the proposed claim area concluded in relation to harbour plume deposition that “Most of the eastern side of the Lower Harbour from Te Rauone Beach to Harwood would be largely unaffected by discharge sources (from the dredge while in operation or during transit to the receiving ground)”. Effects of this would be the temporary presence of visible plume of sediment indicating an increase of suspended sediment in the water column. These effects will be mitigated by:
 - The selection of the sand recovery location from within the Main Claim which is known to be clean sand of appropriate grading – this will be monitored and any parts of the borrow areas that present finer material will be avoided.
 - Ensuring that the pumped sand and seawater mixture is discharged an adequate distance inshore of the water's edge to allow effective settlement of material, and that discharge is managed to take account of the changing tide level to ensure this distance is maintained.
 - Ensuring that pumped discharge of sand and seawater mixture is managed to allow settlement of the sand from the water before it returns to the harbour. This can be achieved by careful management of the discharge location and delivery discharge to ensure low flow velocity drainage, and bunding to allow settlement before return flow of water.
 - Ensuring as far as practicable that clean rock material is used in the groyne construction.

These effects are considered to be minor, and will be monitored and controlled within an appropriate CEMP.

6 Mitigation, Monitoring and Maintenance

The proposed scheme has been developed with input from the Te Rauone Beach Coast Care Committee (TRBCCC) and includes the following mitigation:

Capital works

- As guided by the TRBCCC, shore-perpendicular groynes rather than offshore breakwaters have been incorporated to reduce the impact on potential boat-launching and recovery from the beach, and to better reflect the legacy of shore-perpendicular structures (training walls) in the Otago Harbour.
- Access at the landward end of the central groyne is included to provide access along the beach between the northern and southern embayments. (Note that a similar arrangement at the northern and southern groynes is precluded by the adjacent existing rock revetments although allowance is made for a steps to be provided over the southern groyne for low tide access).
- The southern groyne includes a sand-permeable seaward section to allow for limited movement of sand past the structure, helping to feed the downcoast beach to the south. As a result, the new central beach will also require regular inputs from recycling, and renourishment over time.
- The scheme provides for renourishment of the beach south of the southern groyne to provide a buffer against downcoast effects.
- Locally-sourced sand is proposed for beach renourishment, keeping material within the same coastal compartment.

Operation & maintenance

- Regular recycling of sand within the embayments formed by the groynes is included as part of the operation of the scheme.
- Depending on the results of beach monitoring (refer below), the operation of the scheme may also include regular recycling of sand from the accreting area south-west of the site to the area immediately south of the southern groyne and to the embayment between the central and southern groynes.
- Future renourishment is included in the operation of the scheme, to replace material that is expected to be lost from the system over time. The renourishment sand would likely be sourced from channel dredging or similar.

As indicated in Section 3 and above, the proposed scheme includes observation of the performance of the components, and intervention to provide maintenance as indicated based on the technical review of the observations. POL will be responsible for monitoring, inspection and assessment, and maintenance of the groynes and renourishment. The process for this work will be established in a Maintenance & Operation Plan that will be held by POL and reviewed at regular intervals. An Outline Maintenance & Operation Plan is included in the Detailed Design Report (Beca, 2020). It sets out:

- The proposed frequency and extent of monitoring surveys and inspections.
- The approach to maintenance of renourishment and structures.
- Public access arrangements during maintenance activities.

Should the monitoring identify unanticipated effects on coastal processes, pragmatic mitigation options would be assessed, and a preferred approach developed by POL and provided to ORC for acceptance. Mitigation options could include the placement of more sand than anticipated in conjunction with continued monitoring, modification of the rock components, or ultimately the removal of the groynes.

7 Conclusions

The work proposed at Te Rauone is intended to improve the amenity of the northern section of Te Rauone Beach by providing a high tide berm on the beach. The objective is to restore an above tide useable beach berm and functional beach at Te Rauone.

The proposed scheme includes the construction of three groynes, and the filling of the intermediate embayments and immediately to the south of the groynes, with sand renourishment material.

Assessment, taking into consideration the proposed construction procedure, monitoring and mitigation including future work to maintain the distribution of renourished sand, and to add sand to replace lost material, indicates that coastal processes effects will be minor, and confined to the immediate vicinity of the works. An ongoing Maintenance and Operation Plan will be established to ensure this monitoring and mitigation work will continue over the design life of the installation.

A

Appendix A -References

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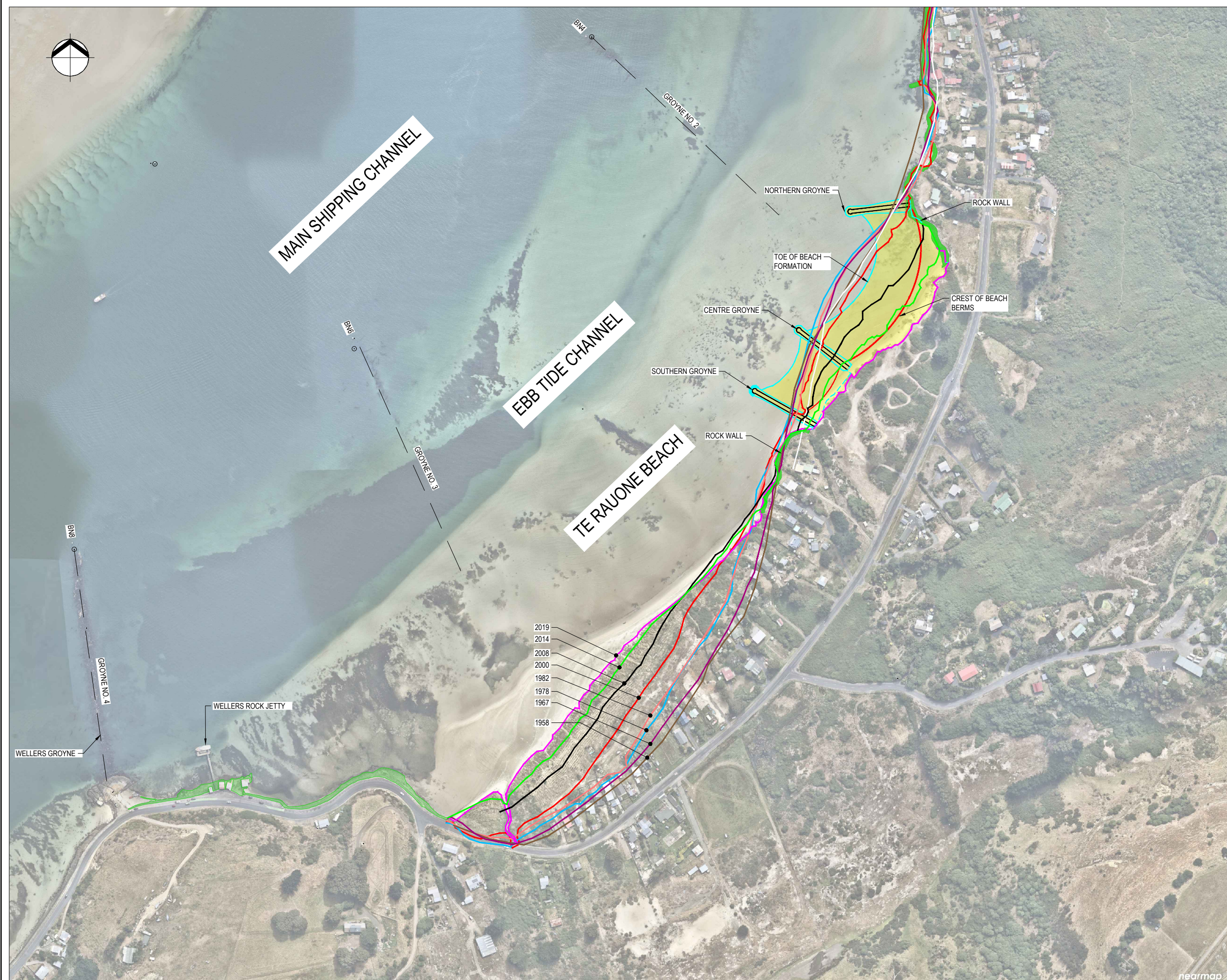
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B

Appendix B – Drawings

1. Beca Drawing No 3331121-SK-001 – PROPOSED WORKS OUTLINE AND RECENT SHORELINES PLOTTED ON 2019 AERIAL PHOTO
2. Port Otago Limited Drawing A3.11863 – TE RAUONE BEACH NOURISHMENT METHODOLOGY PROPOSAL
3. Beca Drawing No 3331121-SK-002 – TEMPORARY CONSTRUCTION AREAS AND ACCESS



LEGEND

- 2019 TOPO LINE
- 2014 TOPO LINE
- 2008 TOE OF DUNES
- 2000 SHORELINE
- 1982 SHORELINE
- 1978 SHORELINE
- 1967 SHORELINE
- 1958 SHORELINE
- BN - CHANNEL MARKER BEACON
- PROPOSED BEACH MANAGEMENT SCHEME EXTENTS
- EXISTING ROCK PROTECTION

- NOTES**
1. SURVEY COMPILED BY PATTERSON PITTS GROUP.
 2. AERIAL PHOTOGRAPHY CAPTURED (20th FEB.)2019 AND OBTAINED FROM NEARMAP.

- 2019
- 2014
- 2008
- 2000
- 1982
- 1978
- 1967
- 1958

ORIGINAL DRAWING
IN COLOUR
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| No. | Revision | By | Ck | Appd | Date |
| A | FOR INFORMATION ONLY | XP | IG | IG | 07.11.19 |

Drawing Originator:

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| Original Scale (A1) | Design | IG | 07.11.19 | Approved For Construction* |
| 1: 2000 | Drawn | XP | 07.11.19 | |
| Reduced Scale (A3) | Disp Verifier | JH | 07.11.19 | Date |
| 1: 4000 | Dwg Check | JH | 07.11.19 | |

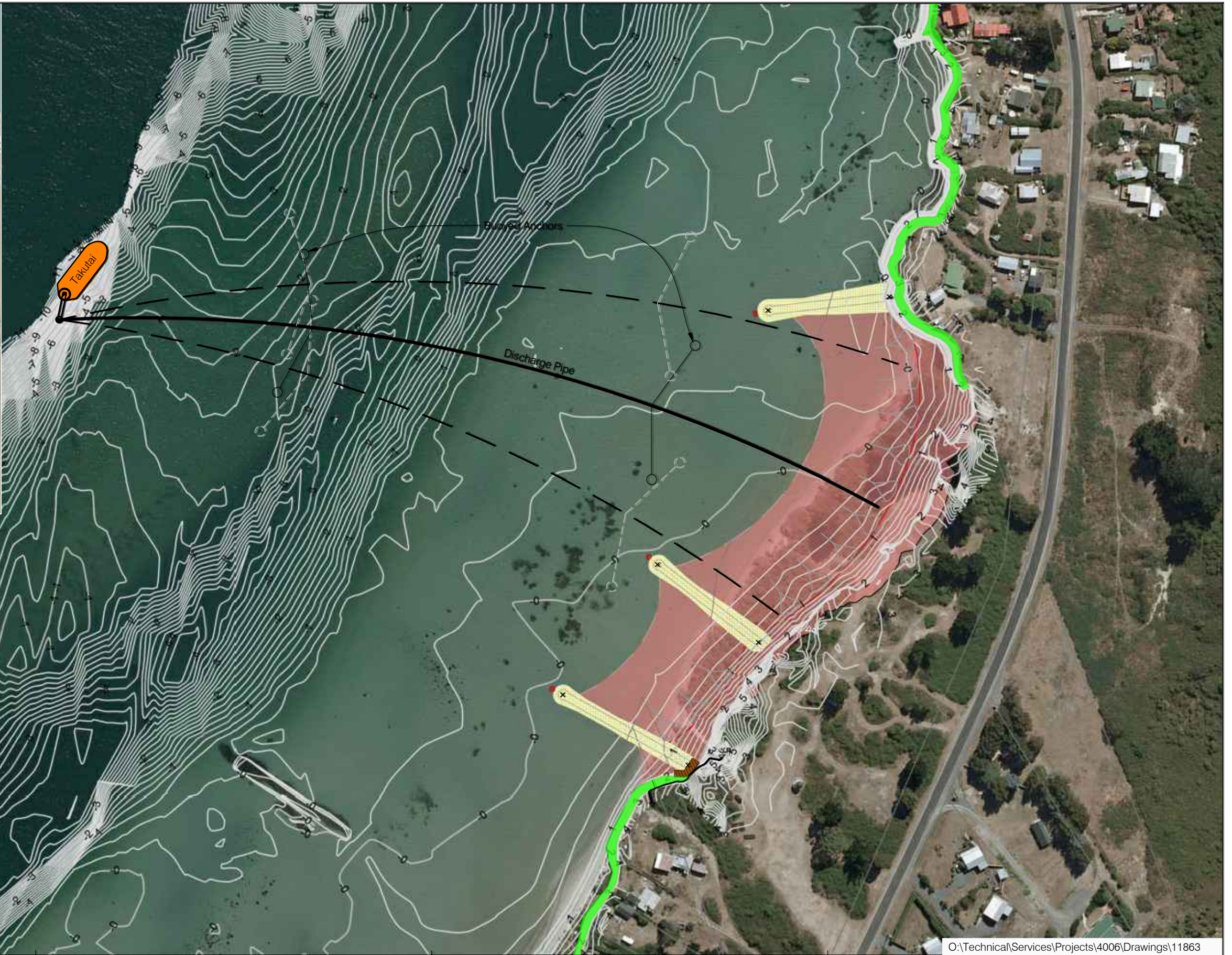
* Refer to Revision 1 for Original Signature

Client:

Project: **TE RAUONE BEACH MANAGEMENT SCHEME**

Title: **PROPOSED WORKS OUTLINE AND RECENT SHORELINES PLOTTED ON 2019 AERIAL PHOTOS**

| | |
|-------------|-------------------|
| Discipline | CIVIL ENGINEERING |
| Drawing No. | 3331121-SK-001 |
| Rev. | A |



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| DESIGNED: | INITIALS | DATE |
| DRAWN: | sb | Oct 2019 |
| CHECKED: | bfc | 22/10/19 |
| APPROVED: | | |

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| PLOT DATE: | 22/10/2019 |
| ISSUE DATE: | |

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| SCALES: | 1:2000 @ A3 |
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PORT OTAGO LTD P.O. Box 8, Port Chalmers, N.Z.

**Te Rauone Beach Nourishment
Methodology Proposal**



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| ACAD FILE NAME: | \Projects\4006\11863 |
| DWG No: | A3. 11863 |



- NOTES:**
1. ALL CONSTRUCTION ACCESSWAYS TO BE APPROXIMATELY 4m WIDE SINGLE LANES.
 2. MINOR AREAS OF VEGETATION OBSTRUCTING THE CONSTRUCTION ACCESS WAY MAY NEED TO BE REMOVED.
 3. PERMISSION REQUIRED FROM RESIDENT OF THE PRIVATE PROPERTY ADJACENT TO THE NORTHERN GROYNE TO GAIN ACCESS TO THE CONSTRUCTION SITE.
 4. CONTRACTOR REQUIRED TO REINSTATE ACCESSES AND ESTABLISHMENT/STORAGE AREA ON COMPLETION OF WORKS.

LEGEND:

- PROPOSED BEACH RENOURISHMENT
- PROPOSED ROCK STRUCTURE
- PROPOSED GROUYNE MARKER
- EXISTING ROCK REVETMENT
- CONSTRUCTION ACCESSWAYS
- SITE ESTABLISHMENT/STORAGE AREA
- DEMARCATED AREA/SITE RESTRICTION BOUNDARY
- EXISTING MHWS (FROM JULY 2017 PPG SURVEY)
- MHWS (WITH PROPOSED RENOURISHMENT)

BEACH OPEN TO PUBLIC



**ORIGINAL DRAWING
IN COLOUR**

**FOR INFORMATION
NOT FOR CONSTRUCTION**

| No. | Revision | By | Chk. | Appd. | Date |
|-----|--------------------------|------|------|-------|----------|
| B | UPDATED CONSENTING ISSUE | CVDM | JH | JH | 09.03.20 |
| A | FOR INFORMATION ONLY | CVDM | JH | JH | 28.02.20 |



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| Original Scale (A1) | Design | - | - | Approved For Construction* |
| 1: 1000 | Drawn | CVDM | 28.02.20 | Date |
| Reduced Scale (A3) | Dwg Verifier | - | - | |
| 1: 2000 | Dwg Check | SS | 09.03.20 | Date |

* Refer to Revision 1 for Original Signature

Client: PORT OTAGO LTD

Project: TE RAUONE BEACH MANAGEMENT SCHEME

Title: TEMPORARY CONSTRUCTION AREAS AND ACCESS

Discipline: CIVIL ENGINEERING

Drawing No: 3331121-SK-002
Rev: B



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Appendix G – Proposed Conditions

Regional Council Consent Conditions

Deposition of Material

1. A total volume of approximately 26,500m³ – 34,000m³ of sand shall be deposited generally as illustrated on drawing number 3331121-CA-103 Rev G prepared by Beca, dated 06.03.20 as part of the initial beach renourishment stage. An updated survey prior to construction works shall be undertaken to determine the final amount of sand required and that volume provided to the Otago Regional Council – Compliance Monitoring prior to the start of construction works.
2. Material deposited onto Te Rauone Beach shall only be derived from dredging material sourced from the Port Otago Harington Bend claim area as authorised by the Regional Plan: Coast for Otago or by resource consent 2010.193.
3. Sand with an average grain size of no less than 0.2mm and with less than 2% fines shall be used for beach renourishment.
4. At the completion on of the re-nourishment works, a final as-built survey will be completed to determine an estimation of the actual volume of sand imported with this being provided to Otago Regional Council – Compliance.
5. That all rock placed within the coastal marine area is as far as practicable, free of foreign material prior to placement.

Construction Environmental Management Plan (CEMP)

6. A CEMP shall be prepared by the principal project contractor prior to construction to meet the requirements of the conditions of this consent and shall include details of groyne construction methodology. The final CEMP must be submitted to the consent authority one month prior to construction.

Maintenance and Operation

7. The works shall be in accordance with the *Outline Maintenance and Operation Plan* provided within the BECA Detailed Design Report dated 12 March 2020. A living Maintenance and Operation Plan (MOP) shall be prepared based on the *Outline Maintenance and Operation Plan* and shall be submitted to Otago Regional Council – Compliance two (2) months following the completion of works. The MOP shall include the following:
 - a) Beach and bathymetric surveys, which shall be at the frequency set out in Condition 8, This shall also include the method of survey to enable assessment of changes in vertical level;
 - b) The survey area shall extend 150m north and south of the project site and 50m seaward of the seaward end of the groyne.
 - c) Outline beach nourishment maintenance and actions post significant storm events, and outline methodology associated with these.
 - d) Inspection of rock structures, markers and signs, which shall be at the frequency set out in Condition 8;
 - e) Outline rock structure maintenance and actions post significant storm events, and outline methodology associated with these;
 - f) Mechanisms for gathering community feedback in regard to groyne and beach conditions with reporting of this feedback provided in line with the beach survey frequency outlined in condition 8 below.
8. That post construction monitoring shall be included in the MOP and shall be undertaken at no less than the following frequencies:

- a) Post-storm inspections of the groynes and renourishment following significant storm events.
 - b) Quarterly beach surveys for the first year after construction;
 - c) Annual beach surveys to be undertaken at 2 and 3 years post construction. The need and frequency of any further beach surveys shall be as set out in a report provided to Council by the consent holder to assess and provide recommendations for monitoring frequency going forward.
 - d) Bathymetric survey within one month following completion of the works; and then at six months and twelve months after completion of works. The need and frequency of any further bathymetric survey shall be as set out in a report provided to Council by the consent holder to assess and provide recommendations for monitoring frequency going forward.
 - e) Annual inspections of the rock groynes, markers and signs for the first three years post construction. The need and frequency of any further inspections shall be as set out in a report provided to Council by the consent holder to assess and provide recommendations for inspections frequency going forward.
 - f) Monitoring results shall also be forwarded to Te Rūnanga o Ōtākou and TRBCCC.
9. The MOP shall be updated as required based on the post-construction monitoring for the maintenance requirements, actions and methodologies (including top up and recycling methods). Following any update, a copy of the updated MOP shall be submitted to Otago Regional Council – Compliance for information.

Public Access

10. The consent holder shall minimise the area and duration of access restriction to the public and disturbance to the foreshore, to the extent necessary for public safety and good construction practice, while undertaking the renourishment and groyne construction work.
11. The consent holder shall only exclude the public from the area of the project works during authorised construction work or maintenance work.

General Conditions

12. All work shall be undertaken between the hours of 7am to 7pm, Monday to Saturday, excluding public holidays.
13. The site shall be left in a clean and tidy state on completion of the authorised works. Disestablishment, including removal of temporary accesses, site offices, plant and any surplus materials and reinstatement of the contractor's site area shall be completed at the end of construction.
14. The consent holder shall ensure that any machinery, including fuel storage tanks, in the construction area shall be cleaned and maintained at all times to prevent leakage of contaminants, including oil or fuel, into the coastal marine area.

Archaeological Protocol

15. That construction works shall not proceed until an Archaeological Authority is in place from Heritage NZ and all protocol associated with the Authority shall be followed.

Ecological Effects

Environmental Management Plan (EMP)

16. An Environmental Management Plan (EMP) shall be prepared with input from a suitably qualified ecologist prior to construction to meet the requirements of the conditions of this

consent and to provide methodology for adaptive management of benthic species and seagrass. The EMP shall also include measures for the management of sea mammals. The final EMP must be submitted to the consent authority one month prior to construction. The EMP shall include:

- a) Baseline data as presented in the Ecological Impact Assessment written by Ryder Environmental and dated April 2020 for marine benthic communities and cockles including:
 - i. A series of marine benthic core samples from within (impact) and adjacent (control) to the scheme footprint to set up a BACI design (before, after, control impact) for the determination of effects.
 - ii. Visual quadrat surveys from within (impact) and adjacent (control) to the scheme footprint to set up a BACI design (before, after, control impact) for the determination of effects.
 - iii. Baseline seagrass survey data from collating available aerial photographs to show seagrass distribution, extent and relative condition (condition measured by assessing percent coverage of seabed by seagrass).
 - b) The following interim timebound benthic species richness and density thresholds for adaptive management for each tidal height within 6 months of works completion:
 - i. Overall percentage occurrence of cockles in benthic samples of the impact site shall remain within 40% of occurrence in control site samples; and
 - ii. Benthic species richness and density (using relative abundance data) of the impact site shall remain within 25 % of species richness and density in the control sites.
 - c) The following interim reductions in seagrass distribution, extent and relative condition thresholds for adaptive management within 6 months of works completion:
 - i. Seagrass distribution, extent and relative condition shall not deviate by >30% of baseline metrics unless such change can be attributable to other effects beyond the scope of the proposed works.

This condition relates to the seagrass beds located immediately south of the scheme footprint only.
 - d) Remediation methods if the pre-set thresholds are met in relation to benthic communities;
 - e) Remediation and rehabilitation methods if pre-set thresholds are met in relation to seagrass beds.
 - f) Methodology for management of sea mammals encountered during project works, including that:
 - i. No vehicles shall drive within 50m of a sea lion, and contractors shall withdraw to at least 50m (or to a greater distance if 50m allows human/sea lion interaction).
 - ii. Eye-contact with sea lions will be avoided by workers, where practicable.
 - iii. The Department of Conservation (DOC) shall be called for assistance and no attempts shall be made to interact/move/scare any sea lion from the project footprint without DOC guidance.
 - iv. If a sea lion is spotted in the ocean, all vehicle and vessel movements and placement of rocks and sand shall be stopped until the location of the sea lion is ascertained and/or the sea lion has been confirmed to have moved away.
17. No works are to be undertaken on Te Rauone beach during mid-December to early February each year to avoid sea lion breeding season.

Benthic Monitoring

18. Benthic monitoring / surveys shall be undertaken post construction, in accordance with the EMP required by condition 16 above, to determine recolonisation rates and be carried out at 6 months post construction.
19. A report summarising the results of the benthic monitoring required by Condition 18 shall be prepared by suitably qualified ecologist(s) and submitted to the Department of Conservation, Te Rūnanga o Ōtākou and Otago Regional Council – Compliance within three months of sampling. The report must analyse the results, report on the interim adaptive management trigger, discuss any trends and review overall ecological effects. The report should recommend if any further benthic monitoring necessary and advise on any necessary adjustments for future monitoring if considered necessary.
20. Where the EMP threshold for adaptive management is triggered, the adaptive management process outlined in Condition 22 shall be commenced.

Sea Grass Monitoring

21. Monitoring of sea grass beds, which occur south of the project footprint, shall be undertaken while the works are being completed to ensure suspended sediment loads do not exceed physical limits (i.e. to ensure beds are not smothered by sediment). Monitoring requirements shall be included within the EMP required by Condition 16 above and shall comprise:
 - i) An aerial survey using a drone shall be undertaken every four weeks during works to determine the distribution and extent of the beds, and the relative sediment-loading of them.
 - ii) Aerial surveys shall continue to be undertaken in Spring and Autumn for three years post-works, to ensure the renourishment works including intermittent “top-ups” of sand/sediment to the beach, does not adversely affect the distribution and extent of the sea grass beds.
 - iii) A report summarising the results of the sea grass aerial surveys shall be prepared by suitably qualified ecologist(s) and submitted to the Department of Conservation, Te Rūnanga o Ōtākou and Otago Regional Council – Compliance within three months of survey. The report must analyse each new set of results. The report may also suggest refinements to the interim trigger for the adaptive management process and advise on any necessary adjustments for future monitoring.
 - iv) Where the EMP threshold for adaptive management is triggered, the adaptive management process outlined in Condition 22 shall be commenced.

Adaptive Management

22. If required by conditions 20 and 21(iv), the consent holder shall commence the adaptive management process. This will include, the project appointed suitably qualified ecologist to evaluate monitoring results and agree actions with the consent holder to remedy any observed effects. These remediation measures shall be undertaken in accordance with the EMP required within Condition 16 above. Details of any adaptive management to be carried out shall be reported to the Department of Conservation, Te Rūnanga o Ōtākou and Otago Regional Council – Compliance prior to implementation.

City Council Consent Conditions

Archaeological Authority

1. That construction works shall not proceed until an Archaeological Authority is obtained from Heritage NZ and all protocol associated with the Authority shall be followed.

Consultation

2. Consultation with the Parks and Recreation Services department (PARS) must be undertaken before any work is carried out on reserve land. The contractor shall forward evidence of communication to the Dunedin City Council – Compliance if requested.

Public Access

3. The contractor shall minimise the area and duration of access restriction to the public and disturbance to the foreshore, to the extent necessary for public safety and good construction practice, while undertaking the renourishment and groyne construction work.
4. The consent holder shall only exclude the public from the area of the project works during authorised construction work and maintenance work.

Construction Environmental Management Plan (CEMP)

A CEMP shall be prepared by the project contractor prior to construction to meet the requirements of the conditions of this consent and shall include details of groyne construction methodology. The final CEMP must be submitted to the consent authority one month prior to construction **Traffic**

Management Plan (TMP)

5. A TMP shall be prepared by the project contractor prior to construction. The TMP shall include, but not be limited to, the following:
 - a) Management of traffic along Harington Point Road adjoining the construction areas;
 - b) Access and parking for contractors; and
 - c) Specification of any additional measures necessary during periods of activities which involve high levels of truck movements and construction vehicles on nearby properties, (including communication and any necessary physical management steps).

Lizard Management

6. A Lizard Management Plan (LMP) shall be developed for the DCC Te Rauone Recreation Reserve that includes the project footprint, in collaboration with DCC PARS, and submitted to the Department of Conservation (DOC) and Otago Regional Council – Compliance, 20 working days prior to construction commencing. The LMP shall outline the actions required to minimise adverse effects on lizards and include:
 - a) The Lizard Management Plan shall be developed by a suitably qualified and experienced herpetologist;
 - b) The Lizard Management Plan shall include, but need not be limited to, the following actions:
 - i. A description of the lizard values of the footprint and adjacent reserve and the actual and potential effects of the construction on these values;
 - ii. Obtaining a Wildlife Permit from the Department of Conservation under the Wildlife Act 1953 to undertake works over the Te Rauone Recreation Reserve that includes the project footprint;
 - iii. Creation of specific lizard habitat of an area commensurate to the area of habitat for lizards likely to occur within the footprint.

- iv. Capture and relocation of lizards;
 - v. Protection of lizards in relation to construction activities and predators;
 - vi. Monitoring to determine survival and population establishment/growth, if more than 20 lizards are able to be relocated.
7. Prior to the commencement of works, any 'no-go' zones identified in the Lizard Management Plan, shall be conveyed to the contractor and marked on the ground for avoidance. In addition to any no-go zones requiring marking, laydown areas and construction vehicle tracks/parking shall only use the tracks and laydown areas as shown on the Beca plan referenced 3331121-SK-002 to further minimise the potential impact on indigenous lizards.

Appendix H – Objectives and Policies

New Zealand Coastal Policy Statement 2010

The New Zealand Coastal Policy Statement (NZCPS) provides objectives and policies to achieve the purpose of the RMA in relation to the coastal environment of New Zealand. The relevant objectives and policies for the proposal are outlined below:

| Objectives and Policies | Comments |
|---|---|
| <p>Objective 1 <i>To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land, by:</i></p> <ul style="list-style-type: none"> • <i>maintaining or enhancing natural biological and physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature;</i> • <i>protecting representative or significant natural ecosystems and sites of biological importance and maintaining the diversity of New Zealand’s indigenous coastal flora and fauna; and</i> • <i>maintaining coastal water quality, and enhancing it where it has deteriorated from what would otherwise be its natural condition, with significant adverse effects on ecology and habitat, because of discharges associated with human activity.</i> | <p>The proposed works aim to re-establish Te Rauone Beach and increase its resilience against coastal erosion for public amenity gain.</p> <p>As outlined in Section 6, the works aim to re-establish the natural form of the beach which will provide greater habitat for indigenous flora and fauna.</p> <p>Discharges will occur as deposition of sand is deposited on the beach during the works period. However, as outlined in Section 6, this discharge will only be temporary and made up of sand and sea water pumped ashore from the Otago Harbour.</p> |
| <p>Objective 2 <i>To preserve the natural character of the coastal environment and protect natural features and landscape values through:</i></p> <ul style="list-style-type: none"> • <i>recognising the characteristics and qualities that contribute to natural character, natural features and landscape values and their location and distribution;</i> • <i>identifying those areas where various forms of subdivision, use, and development would be inappropriate and protecting them from such activities; and</i> • <i>encouraging restoration of the coastal environment.</i> | <p>The proposed works recognise and aim to re-establish the natural characteristics of Te Rauone Beach through its restoration.</p> <p>While this will require the construction of three engineering structures in the coastal marine area (rock groynes) the restoration of the beach berm will enhance the natural character of the beach.</p> |
| <p>Objective 3 <i>To take account of the principles of the Treaty of Waitangi, recognise the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment by:</i></p> <ul style="list-style-type: none"> • <i>recognising the ongoing and enduring relationship of tangata whenua over their lands, rohe and resources;</i> | <p>Te Rūnanga o Ōtākou, the kaitiaki Rūnanga whose takiwā includes the site the application relates to, do not oppose the application. It is recognised that Te Rauone Beach has significant meaning to tangata whenua and the reinstatement of</p> |

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| <ul style="list-style-type: none"> • <i>promoting meaningful relationships and interactions between tangata whenua and persons exercising functions and powers under the Act;</i> • <i>incorporating mātauranga Māori into sustainable management practices; and</i> • <i>recognising and protecting characteristics of the coastal environment that are of special value to tangata whenua.</i> | <p>the beach, will allow for this significance to be maintained.</p> <p>Kaimoana will be enhanced over time through the protection works and access to the beach and sea will be maintained.</p> |
| <p>Objective 4 <i>To maintain and enhance the public open space qualities and recreation opportunities of the coastal environment by:</i></p> <ul style="list-style-type: none"> • <i>recognising that the coastal marine area is an extensive area of public space for the public to use and enjoy;</i> • <i>maintaining and enhancing public walking access to and along the coastal marine area without charge, and where there are exceptional reasons that mean this is not practicable providing alternative linking access close to the coastal marine area; and</i> • <i>recognising the potential for coastal processes, including those likely to be affected by climate change, to restrict access to the coastal environment and the need to ensure that public access is maintained even when the coastal marine area advances inland.</i> | <p>The proposed works will increase public access, recreational opportunities and the amenity values of Te Rauone Beach by re-establishing the beach.</p> <p>Some access restrictions will be established during the construction period, however this will only be temporary.</p> |
| <p>Policy 14 <i>Restoration of natural character</i></p> <p><i>Promote restoration or rehabilitation of the natural character of the coastal environment, including by :</i></p> <p><i>(a) identifying areas and opportunities for restoration or rehabilitation;</i></p> <p><i>(b) providing policies, rules and other methods directed at restoration or rehabilitation in regional policy statements, and plans;</i></p> <p><i>(c) where practicable, imposing or reviewing restoration or rehabilitation conditions on resource consents and designations, including for the continuation of activities; and recognising that where degraded areas of the coastal environment require restoration or rehabilitation...</i></p> | <p>As identified above (Objective 2), the re-establishment of the beach will enhance and restore parts of the natural character of the beach through reintroduction of fauna and sea mammals.</p> <p>It is recognised that the natural character of the beach will be significantly altered, however, the positive effects are considered to outweigh these. The project does directly provide for the restoration and rehabilitation of the beach and so is considered to be in keeping with this policy.</p> |
| <p>Policy 16 <i>Surf breaks of national significance</i> <i>Protect the surf breaks of national significance for surfing listed in Schedule 1, by:</i></p> <p><i>(a) ensuring that activities in the coastal environment do not adversely affect the surf breaks; and</i></p> <p><i>(b) avoiding adverse effects of other activities on access to, and use and enjoyment of the surf breaks.</i></p> | <p>As identified in the Coastal Processes Assessment contained in Appendix F, the small magnitude of the changes to the coastline at Te Rauone Beach will not have an effect on the nationally significant surf break at Aramoana (The Spit).</p> |
| <p>Policy 19 <i>Walking access</i></p> | <p>As above the works provide for public access.</p> |

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| <p>(1) <i>Recognise the public expectation of and need for walking access to and along the coast that is practical, free of charge and safe for pedestrian use.</i></p> <p>(2) <i>Maintain and enhance public walking access to, along and adjacent to the coastal marine area,</i></p> <p>...</p> | |
| <p>Policy 26 <i>Natural defences against coastal hazards</i></p> <p>(1) <i>Provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or sites of significant biodiversity, cultural or historic heritage or geological value, from coastal hazards.</i></p> <p>(2) <i>Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands.</i></p> | <p>The proposed works will re-establish the beach at Te Rauone allowing for the regeneration of the sand dunes and beach front.</p> <p>Coastal engineering is the proposed method to achieve the desired outcome for the beach as erosion processes in the area are too strong for enhancement of natural defences to be established and successful.</p> |
| <p>Policy 27 <i>Strategies for protecting significant existing development from coastal hazard risk</i></p> <p>(1) <i>In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes:</i></p> <p>(a) <i>promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk;</i></p> <p>(b) <i>identifying the consequences of potential strategic options relative to the option of ‘do-nothing’;</i></p> <p>(c) <i>recognising that hard protection structures may be the only practical means to protect existing infrastructure of national or regional importance, to sustain the potential of built physical resources to meet the reasonably foreseeable needs of future generations;</i></p> <p>(d) <i>recognising and considering the environmental and social costs of permitting hard protection structures to protect private property; and</i></p> <p>(e) <i>identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches.</i></p> <p>(2) <i>In evaluating options under (1):</i></p> <p>(a) <i>focus on approaches to risk management that reduce the need for</i></p> <p>(b) <i>take into account the nature of the coastal hazard risk and how it might change over at least a 100-year timeframe, including the expected effects of climate change; and</i></p> <p>(c) <i>evaluate the likely costs and benefits of any proposed coastal hazard risk reduction options.</i></p> | <p>The hard protection structures proposed to be located on Te Rauone Beach have been decided upon through the strong desire of the TRBCCC and residents to rehabilitate the beach.</p> <p>They see that there is significant public benefit in re-establishing the beach. The options assessment associated with the project identified that the proposed hard structures are the most efficient and practical solution for the re-instatement of Te Rauone Beach.</p> <p>The option of the ‘do nothing’ approach will see an important community asset and significant cultural feature to retreat to a point where its values would be lost.</p> <p>The detailed design has considered climate change.</p> |

(3) Where hard protection structures are considered to be necessary, ensure that the form and location of any structures are designed to minimise adverse effects on the coastal environment.

(4) Hard protection structures, where considered necessary to protect private assets, should not be located on public land if there is no significant public or environmental benefit in doing so.

In summary it is considered the relevant objectives and policies of the NZCPS are able to be met by the project.

Partially Operative Regional Policy Statement 2019

The Partially Operative Regional Policy Statement (PORPS) contains a high level policy framework for the sustainable integrated management of Otago’s natural and physical resources, to be managed by the region’s local authorities. The relevant objectives and policies for the proposal are outlined below:

| Objectives and Policies | Comments |
|--|---|
| <p>Objective 2.2 Kāi Tahu values, interests and customary resources are recognised and provided for</p> | <p>As discussed above, the reinstatement of Te Rauone Beach will provide for tangata whenua to continue customary uses and enhance maintain the values they hold for Te Rauone.</p> |
| <p>Policy 2.2.1 - Kāi Tahu wellbeing</p> <p>Manage the natural environment to support Kāi Tahu wellbeing by all of the following:</p> <p>(a) Recognising and providing for their customary uses and cultural values in Schedules 1A and B; and,</p> <p>(b) Safe-guarding the life-supporting capacity of natural resources.</p> | |
| <p>Policy 2.2.3 Wāhi tūpuna and associated sites</p> <p>Enable Kāi Tahu relationships with wāhi tūpuna by all of the following:</p> <p>(a) Recognising that relationships between sites of cultural significance are an important element of wāhi tūpuna;</p> <p>(b) Recognising and using traditional place names.</p> | |
| <p>Objective 4.1 Risks that natural hazards pose to Otago’s communities are minimised</p> | |

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| | <p>properties at the northern extent of Te Rauone Beach and the Te Rauone Beach Reserve.</p> <p>A reinstated beach may also reduce potential future impacts of coastal erosion on Harington Point Road.</p> |
| <p>Policy 4.1.7 Reducing existing natural hazard risk</p> <p><i>Reduce existing natural hazard risk to people and communities, including by all of the following:</i></p> <ul style="list-style-type: none"> <i>(a) Encouraging activities that:</i> <ul style="list-style-type: none"> <i>(i) Reduce risk; or</i> <i>(ii) Reduce community vulnerability;</i> <i>b) Discouraging activities that:</i> <ul style="list-style-type: none"> <i>(i) Increase risk; or</i> <i>(ii) Increase community vulnerability;</i> <i>(c) Considering the use of exit strategies for areas of significant risk to people and communities;</i> <i>(d) Encouraging design that facilitates:</i> <ul style="list-style-type: none"> <i>(i) Recovery from natural hazard events; or</i> <i>(ii) Relocation to areas of lower risk; or</i> <i>(iii) Mitigation of risk;</i> <i>(e) Relocating lifeline utilities, and facilities for essential and emergency service, to areas of reduced risk, where appropriate and practicable;</i> <i>(f) Enabling development, upgrade, maintenance and operation of lifeline utilities and facilities for essential and emergency services;</i> <i>(g) Reassessing natural hazard risk to people and communities, and community tolerance of that risk, following significant natural hazard events.</i> | <p>The proposed works respond to the risk of ongoing erosion at Te Rauone Beach.</p> |
| <p>Policy 4.1.11 Hard protection structures</p> <p><i>Enable the location of hard protection structures or similar engineering interventions on public land only when either or both of the following apply:</i></p> <ul style="list-style-type: none"> <i>(a) There is significant public or environmental benefit in doing so;</i> <i>(b) The work relates to the functioning ability of a lifeline utility, or a facility for essential or emergency services.</i> | <p>Port Otago and TRBCCC consider that there is significant public benefit in re-establishing Te Rauone Beach.</p> <p>The beach will remain one of the few remaining sandy beaches located on the western side of the peninsula which is heavily sea walled.</p> <p>The amenity and recreational opportunities the beach would provide in the area is considered justifiable for hard protection structures to be developed, in order to protect the beach.</p> |

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| <p>Objective 5.1</p> <p><i>Public access to areas of value to the community is maintained or enhanced</i></p> | <p>Following the works, public access to the beach will be maintained.</p> <p>Access to Te Rauone Beach will be enhanced through the re-establishment of the beach berm. Currently no high tide beach berm is present at Te Rauone Beach during high tide.</p> |
| <p>Policy 5.1.1 Public access</p> <p><i>Maintain or enhance public access to the natural environment, including to the coast, lakes, rivers and their margins, and where possible areas of cultural or historic significance, unless restricting access is necessary for one or more of the following:</i></p> <p>(a) <i>Protecting public health and safety;</i></p> <p>(b) <i>Protecting the natural heritage and ecosystem values of sensitive natural areas or habitats;</i></p> <p>(c) <i>Protecting identified sites and values associated with historic heritage or cultural significance to Kāi Tahu;</i></p> <p>(d) <i>Ensuring a level of security consistent with the operational requirements of a lawfully established activity.</i></p> | <p>Following the works, public access to the beach will be maintained.</p> <p>Temporary access restrictions will be put in place during construction to ensure public safety.</p> |

In summary it is considered the relevant objectives and policies of the PORPS are able to be met by the project.

Regional Plan: Coast for Otago

The RPC provides a policy framework specific to Otago's coastal environment. The relevant objectives and policies for the proposal are outlined below:

| Objectives and Policies | Comments |
|--|--|
| <p>Objective 5.3.1</p> <p><i>To provide for the use and development of Otago's coastal marine area while maintaining or enhancing its natural character, outstanding natural features and landscapes, and its ecosystem, amenity, cultural and historical values.</i></p> | <p>The proposed works provide for the use of Te Rauone Beach while enhancing its natural character and amenity through its re-establishment and protection from ongoing erosion.</p> <p>The ecosystems of the beach will be temporarily affected by the works but are expected to regenerate, possibly even increasing as a result of the works.</p> |
| <p>Policy 5.4.6</p> <p><i>Priority will be given to the need to provide for and protect the values associated with the coastal recreation areas when considering the use, development and protection of Otago's coastal marine area.</i></p> | <p>The proposed works will enhance the recreational values of Te Rauone Beach through its re-establishment as a sandy beach which is accessible for recreational activities even during high tide.</p> |

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| <p>Objective 7.3.1</p> <p><i>To maintain and as far as practical enhance public access to Otago's coastal marine area.</i></p> | <p>The proposed works will ultimately enhance accessibility to Te Rauone Beach through the re-establishment of the beach berm. Currently Te Rauone Beach provides limited access and recreational opportunities especially during high tide.</p> |
| <p>Policy 7.4.3</p> <p><i>Public access to and along the margins of the coastal marine area will only be restricted where necessary:</i></p> <ul style="list-style-type: none"> <i>(a) To protect areas of significant indigenous vegetation and/or significant habitats of indigenous fauna; or</i> <i>(b) To protect Maori cultural values; or</i> <i>(c) To protect public health or safety; or</i> <i>(d) To ensure a level of security consistent with the purposes of a resource consent; or</i> <i>(e) To facilitate temporary Navy defence operations in Otago Harbour; or</i> <i>(f) In other exceptional circumstances sufficient to justify the restriction.</i> | <p>Public access will only be restricted during the construction period to ensure public safety.</p> |
| <p>Objective 8.3.1</p> <p><i>To recognise and provide for values associated with:</i></p> <ul style="list-style-type: none"> <i>(a) Areas of cultural significance; and</i> <i>(b) Areas of conservation value; and</i> <i>(c) Areas of public amenity;</i> <p><i>when considering structures within the coastal marine area.</i></p> | <p>The proposed works aim to increase public amenity of Te Rauone Beach following its degradation as a result of advanced erosion.</p> |
| <p>Objective 8.3.3</p> <p><i>To provide for the development of appropriate new structures and maintenance of existing structures, whilst minimising the use of structures for activities which do not require a coastal marine area location.</i></p> | <p>The groyne structures proposed are considered appropriate to achieve the goal of restoring the beach and protecting it from the ongoing effects of erosion.</p> |
| <p>Objective 8.3.4</p> <p><i>To take into account the effects of natural physical coastal processes when considering structures in the coastal marine area.</i></p> | <p>The Coastal Process Assessment (Appendix F) has confirmed that the development of the rock groynes will have a less than minor effects on the natural coastal process of Otago Harbour.</p> <p>Design features such as the sediment permeable southern groyne will allow sediment to still move naturally down the coast while reducing the erosion at Te Rauone Beach.</p> |

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| <p>Pol 8.4.4</p> <p><i>New structures will be avoided, as far as is practicable, in areas of open space, and in areas of little or no development, in order that the amenity values associated with those areas are maintained or enhanced.</i></p> | <p>The benefits to local amenity values of re-establishing Te Rauone Beach is expected to be greater than any visual impacts the structures will have as a result of being located in the coastal marine area.</p> |
| <p>Policy 8.4.5</p> <p><i>New and existing structures will be required to be maintained in a structurally sound and tidy state, and should blend as far as is practicable with the adjoining landscape to minimise the visual impact of that structure on the character of the area.</i></p> | <p>Ongoing maintenance and monitoring of the beach works and rock groyne structures is proposed,</p> <p>The structures are constructed of rock with their seaward end located at Mean Sea Level to reduce their visual effects.</p> |
| <p>Objective 9.3.1</p> <p><i>To recognise and provide for values associated with:</i></p> <ul style="list-style-type: none"> <i>(a) Areas of cultural significance; and</i> <i>(b) Areas of conservation value; and</i> <i>(c) Areas of public amenity;</i> <p><i>when considering any alteration of the foreshore or seabed within the coastal marine area.</i></p> | <p>The deposition of sand onto Te Rauone Beach and the erosion protection proposed will increase public amenity through the re-establishment and protection of the beach.</p> <p>The increase in sand and reduced erosion will also provide noticeable benefits for local habitat as identified in the Ecological Assessment (Appendix E).</p> |
| <p>Objective 9.3.2</p> <p><i>To preserve the natural character of Otago’s coastal marine area as far as practicable from the adverse effects associated with any alteration of the foreshore or seabed.</i></p> | <p>The proposed works will increase the natural character of the Otago Harbour through re-establishing the Te Rauone Beach. The natural character of the beach has been significantly degraded through advanced coastal erosion.</p> |
| <p>Objective 9.3.3</p> <p><i>To take into account the effects of natural physical coastal processes when considering activities which alter the foreshore or seabed in the coastal marine area.</i></p> | <p>As identified above, the rock groynes have been designed in a way which allows retainment of sediment on Te Rauone Beach while still letting some natural movement down the coast.</p> <p>The effects on coastal process as a result of the proposed works have been considered as less than minor in the Coastal Process Assessment (Appendix F).</p> |
| <p>Policy 9.4.6</p> <p><i>The integrity of natural features such as beaches, sand dunes, salt marshes, wetlands, and barrier islands, and their ability to protect areas above the line of mean high</i></p> | <p>The proposed construction of the rock groynes and deposition of sand on Te Rauone Beach will enhance the natural features of the area by</p> |

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| <i>water springs from natural physical coastal processes will be maintained and enhanced wherever practicable.</i> | maintaining the beach and protecting it from ongoing erosion. |
| <p>Policy 9.4.8</p> <p><i>For the following activities, consideration will be given to the reasons for undertaking the activity in the coastal marine area, the public benefit to be derived and to any other available alternatives:</i></p> <p>(a) Any reclamation; or</p> <p>(b) The removal of sand, shingle, shell or other natural materials for commercial purposes; or</p> <p>(c) Any deposition of material.</p> | The sand deposited ashore will only be that necessary to re-establish Te Rauone Beach. The sand will be sourced from Harington Bend Claim to ensure only clean sand is deposited and that of a similar grain size to that natural present on the beach. |
| <p>Policy 9.4.10</p> <p><i>Alterations of the foreshore and seabed should blend as far as is practicable with the adjoining landscape to minimise the visual impact of the alteration on the character of the area.</i></p> | <p>The sand deposited on Te Rauone Beach will be a matching grain size and type to ensure the imported sand match that present on the beach.</p> <p>The rock groynes have been designed to be at Mean Sea Level at their seaward end to reduce visual impacts.</p> |
| <p>Objective 10.3.3</p> <p><i>To safeguard the life-supporting capacity of Otago's coastal marine area.</i></p> | The re-establishment of Te Rauone Beach will allow for increased habitat for local flora and fauna following the works. |

In summary it is considered the relevant objectives and policies of the RPC are able to be met by the project.

Second Generation Dunedin City District Plan (2GP)

| Objectives and Policies | Comments |
|---|--|
| <p>Objective 8A.2.1</p> <p><i>Earthworks necessary for permitted or approved land use and development are enabled, while avoiding, or adequately mitigating, any adverse effects on:</i></p> <p>a. visual amenity and character;</p> <p>b. the stability of land, buildings, and structures; and</p> <p>c. surrounding properties.</p> | <p>The proposed works are expected to improve the amenity values of the wider Te Rauone Beach Reserve area through the re-establishment of the beach.</p> <p>This coupled with the proposed future DCC works in the reserve will enhance the character of the recreation zone.</p> <p>Earthworks will not affect the stability of surrounding buildings, structures or properties.</p> |

Policy 8A.2.1.3

Only allow earthworks that exceed the scale thresholds (earthworks - large scale) and any associated retaining structures, where the following effects will be avoided or, if avoidance is not practicable, adequately mitigated:

- a. adverse effects on visual amenity and character;*
- b. adverse effects on the amenity of surrounding properties, including from changes to drainage patterns; and*
- c. adverse effects on the stability of land, buildings, and structures.*

The erosion occurring at Te Rauone Beach has significantly degraded the amenity of the area as use of the beach by local residents and visitors is constrained. The proposed earthworks will assist in improving the amenity and character of the beach and may assist with improving erosion effects on neighbouring properties.

There will be no adverse effects in association with stability of neighbouring properties, buildings or structures.

In summary it is considered the relevant objectives and policies of the 2GP are able to be met by the project.

Appendix I - Consultation

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| DATE | ATTENDEES | DISCUSSION |
|-------------------|---|--|
| 2008 | | |
| 16 February 2008 | First Public Meeting Marae, Port Otago Geoff Plunket, ORC, DCC, OPCB, land owners and community | General discussion/proposal Commitment from PO re Beach. |
| 2009 | | |
| 3 June 2009 | Site meeting with Port Otago Board and Management followed by meeting at Marae | Proposal |
| 14 July 2009 | First meeting TRBCCC (Hoani Langsbury Chairperson) | Proposed concept – Martin Single |
| 2010 | | |
| 2 September 2010 | Second meeting at Marae attendance 40-50 | Outline single breakwater |
| 2011 | | |
| 5 August 2011 | Port Otago Management and TRBCCC | New plan of 12 July 2011 and Application for Resource Consent document |
| 2 November 2011 | At Marae Port Otago/TRBCCC | Costings |
| 2014 | | |
| 26 June 2014 | Public Meeting at Albatross Centre | Breakwater update/costings; TRBCCC reformed |
| 3 July 2014 | First Meeting reformed TRBCCC(Graeme Burns Chairperson) | Election of officers and duties |
| 17 July 2014 | TRBCCC Committee | Fundraising |
| 30 July 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 13 August 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 28 August 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 11 September 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 24 September 2014 | PO Meeting – Geoff Plunket, Steve Bennett, Graeme Burns, Des Smith | Funding Breakwater |
| 25 September 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 9 October 2014 | TRBCCC Committee | Booklet, newsletter, fundraising |
| 23 October 2014 | TRBCCC Committee | Booklet, newsletter, fundraising, Public Meeting |
| 27 October 2014 | Public Meeting Des Smiths Garage, 80-90 attended and apologies | Outline single breakwater proposal funding/calendar sales |
| 6 November 2014 | TRBCCC Committee | Fundraising, upcoming meeting PO |
| 13 November 2014 | OPCB and Graeme Burns | Application for funding |
| 18 November 2014 | TRBCCC/PO (Lincoln Coe), Steve Bennett(DIF), Eleanor Murphy(TRI) | Detailed explanation single breakwater/whole beach restoration |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| | | |
|--------------------------------|--|---|
| 1 December 2014 | Otago Community Trust, TRBCCC and several community people | Visit to see sites and hear proposal |
| 9 December 2014 | At PO Geoff Plunket, Graeme Burns Des Smith, Steve Bennett | Fundraising Community Share tender costings received by PO, resource consent not yet lodged |
| 11 December 2014 | TRBCCC Committee | Report on 9 December meeting fundraising/commitments |
| 2015 | | |
| 15 January 2015 | TRBCCC Committee | Fundraising/confirmation |
| 12 February 2015 | TRBCCC Committee with DCC rep Lisa Wheeler | Fundraising/OPCB project number 2/Regular contact with Mick Reece & Doug Hall(DCC), Sam Neill(ORC), Andy Pullar(PO), Michael Woodhouse(MP), Letters of support. |
| 27 February 2015 | TRBCCC Committee | Costings breakwater |
| 6 March 2015 | TRBCCC present-Graeme Burns, Des Smith, DCC - Doug Hall, Andrew Noone, Neville Peat, Lisa Wheeler, ORC Trevor Kempton, Sam Neill | Breakwater costing and possible extra funding |
| 20 March 2015 | TRBCCC Committee and Steve Clearwater | Costings breakwater |
| 16 April 2015 | TRBCCC Committee | Steve Clearwater amended costing breakwater submitted to PO 12 April 2015 |
| 14 May 2015 | TRBCCC Committee | Fundraising/Steve Clearwater amended costing |
| Between above and 18 June 2015 | TRBCCC present – Graeme Burns, Des Smith PO Geoff Plunket, Andy Pullar DIA Steve Bennett | Breakwater cost now \$290,000 (Steve Clearwater) Contractor – Steve Clearwater |
| 18 June 2015 | Facilitation meeting with TRBCCC present – Graeme Burns, Des Smith DCC – Doug Hall, Andrew Noone, Neville Peat, Chris Garey, Lisa Wheeler ORC Trevor Kempton, Sam Neill, Michael Deaker, Steve Bennett | Updating progress |
| 13 July 2015 | TRBCCC present Graeme Burns, Des Smith PO Geoff Plunkett, DCC Lisa Wheeler | Breakwater cost now attainable |
| 16 July 2015 | TRBCCC Committee | General |
| 17 August 2015 | Des Smith with Andrew Noone(DCC) and Geoff Plunket PO | PO wanting DCC to purchase sand for St Clair to “subsidise” breakwater |
| 20 August 2015 | TRBCCC Committee | Reports |
| 16 September 2015 | TRBCCC Committee | PO Board did not discuss |
| 1 October 2015 | TRBCCC Committee | Strategy planning |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| | | |
|------------------|---|--|
| 13 October 2015 | Graeme Burns, Des Smith, Edward Ellison, Geoff Plunket | To sort out Geoff's issues at suggestion Dave Faulkner |
| 16 October 2015 | TRBCCC Committee with Edward Ellison, Christine Garey OPCB, Sam Neill ORC, Neville Peat DCC | Information pack posted to PO Board. Information pack delivered to Geoff Plunket. Response G Plunket – deal with Board |
| 26 October 2015 | Public Meeting, 960 Harington Point Road, 80-90 attended and included including Edward Ellison, Doug Hall, Chris Garey, Eleanor Murphy, Andrew Noone, Neville Peat, Sam Neill and Paul Pope | Summary of progress. Commitments from Stakeholders/Community |
| 19 November 2015 | TRBCCC Committee | Reports/fundraising |
| 7 December 2015 | Graeme McLean, Des Smith, Edna Stevenson with DCC Gareth Evans, Michael Harrison and Steve Clearwater | "Smooth wall" issue |
| 14 December 2015 | TRBCCC Committee with Martin Single | Breakwater concept best option |
| 21 December 2015 | TRBCCC Committee | Reports/fundraising |
| 2016 | | |
| 28 January 2016 | TRBCCC Committee | General |
| 6 February 2016 | Waitangi Day | Organised Public Picnic - Fundraiser |
| 23 February 2016 | TRBCCC Committee | Internal discussions |
| 22 March 2016 | TRBCCC Committee | General, Appeal re Community Boards attended by Graeme Burns |
| 19 April 2016 | TRBCCC Committee | Alternative suggestions breakwater ex PO 15 April |
| 2 May 2016 | TRBCCC Committee – present G Burns, D Smith, Edna Stevenson Andrew Noone –DCC, Chris Garey OPCB, with PO Dave Faulkner and Geoff Plunket | Commitment made on existing one breakwater proposal proceed with final design etc. |
| 3 May 2016 | TRBCCC Committee | Reports on above and other meetings |
| 17 May 2016 | TBRCCC Committee | Send replenishment breakwater design |
| 18 May 2016 | Des Smith & Dave Faulkner(PO Chairman) | One of a number of phone calls to discuss project |
| 30 May 2016 | TRBCCC Newsletter | Community Update |
| 31 May 2016 | TRBCCC Committee | Options discussed |
| 5 June 2016 | TRBCCC Committee | Special following resignations Ainslie and Nicola |
| 14 June 2016 | TRBCCC Committee | Funding, erosion, email PO re Beca final design |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| | | |
|-------------------|--|---|
| 22 June 2016 | Beca Meeting – Robert Crosbie, Jennifer Hart, Peter O’Brien, Des Smith | Discussion of Project |
| 12 July 2016 | TRBCCC Meeting | Project report back |
| 20 July 2016 | Steve Bennett & Des Smith | Update on project |
| 25 July 2016 | TRBCCC Committee with PO Geoff Plunket and Andy Pullar at Port Chalmers | Receive Beca design report original concept not workable alternative suggestions made |
| 26 July 2016 | TRBCCC Committee | Chris Garey, Sam Neill – Update and advisors |
| 27 July 2016 | One of many meetings between Edward Ellison & Des Smith | Project update |
| 27 July 2016 | Nick Maguire, Hamish Black(DCC), Des Smith | Tree stumps, signs |
| 30 July 2016 | Edward Ellison and Des Smith | Discussion on project |
| 2 August 2016 | TRBCCC Committee | Preparation workshop meeting with Beca |
| 5 August 2016 | DCC & Des Smith | Further discussions on Reserve |
| 8 August 2016 | TRBCCC Committee with Beca | Workshop - New concept |
| 6 September 2016 | TRBCCC Committee | Consideration of Beca’s report |
| 9 September 2016 | Hamish Black(DCC) & Des Smith | Te Rauone Reserve |
| 20 September 2016 | TBRCCC Committee | Consideration of Beca’s report |
| 9 October 2016 | TRBCCC Committee | Consideration of Beca’s report, costings now far beyond expectation |
| 12 October 2016 | TRBCCC Committee with Port Otago Dave Faulkner and Rene Baks | Alternatives groynes |
| 18 October 2016 | TRBCCC Committee | Alternative groynes |
| 24 October 2016 | Public Meeting, 960 Harington Point Road about 80 people attended | Progress reports alternative design |
| 8 November 2016 | TRBCCC Committee | General re alternative design |
| 11 November 2016 | Jennifer Hart(Beca) & Des Smith phone conversation | Discussion on project |
| 17 November 2016 | Coastal Conference – delegates met at 960 Harington Point Road (Des Smith) | Presentation on Beach Project |
| 17 November 2016 | Meeting between Geoff Plunket & Des Smith | Project discussion |
| 22 November 2016 | TRBCCC Committee | Special meeting before meeting with Advisers re deadlock |
| 1 December 2016 | Graeme Burns, Des Smith, Chris Garey met with Dave Cull | “Ground breaker” headed email Geoff Plunket “effectively its our way or no way” |
| 5 December 2016 | TRBCCC Committee | Reports as above |
| 8 December 2016 | Met with ORC Stephen Woodhead/Sam Neill and PO David Faulkner | To consider deadlock |
| 9 December 2016 | Des Smith met with Tom Dyer & Hamish Black(DCC) | State of Reserve |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| | | |
|-------------------|---|---|
| 13 December 2016 | TRBCCC Committee (Special Meeting) | To consider matter for forthcoming meeting with ORC/DCC/OPCB and Edward Ellison |
| 19 December 2016 | TRBCCC Committee with Dave Cull, Dave Faulkner, Peter Bodeker, Paul Pope, Edward Ellison, Gretchen Robertson, Kate Wilson, Stephen Woodhead | The way forward |
| 2017 | | |
| 12 February 2017 | TRBCCC Committee | Next meeting with combined group |
| 14 February 2017 | Combined Group at ORC offices | Way forward groynes |
| 21 February 2017 | TRBCCC Committee | General re above |
| 8 March 2017 | PO Seminar on Harbour Environment – Des Smith | General discussion on overall plan |
| 16 March 2017 | TRBCCC Committee | Repeats 12 March with Beca, PO |
| 21 March 2017 | TRBCCC Committee | ORC Visit |
| 21 March 2017 | TRBCCC Newsletter | Community Update |
| 29 March 2017 | Paul Pope & others, Des Smith | Update on project |
| 15 April 2017 | TRBCCC Committee | General |
| 15 April 2017 | Public Meeting at 960 Harington Point Road, about 50 attended | Outlined background and new proposals combined group |
| 20 April 2017 | Jennifer Hart, Richard Young & Rob Crosbie site meeting with Des Smith | Project over view |
| 2 May 2017 | Barbara Bridger & Carol Melville(OCT) met with Des Smith | Project funding |
| 2 May 2017 | TRBCCC Meeting | Report back |
| 16 August 2017 | Public Meeting | Update on Beach Project |
| 19 September 2017 | TRBCCC Newsletter | Community Update |
| 8 October 2017 | TRBCCC Meeting | Prepare for meeting with PO |
| 10 October 2017 | TRBCCC Committee with Kevin Winders new CEO and Shaun Bolt | First meeting with Kevin his way forward |
| 19 October 2017 | TRBCCC Meeting | Prepare for Public Meeting |
| 23 October 2017 | Public Meeting at 960 Harington Point Road, about 60 people attended | Report Meeting |
| 1 November 2017 | Meeting – Kevin Winders & Des Smith | Site meeting |
| 1 November 2017 | TRBCCC Committee with Kevin Winders and Shaun Bolt | Summary presented points raised at public Meeting of October 2017 |
| 22 November 2017 | Sue Bidrose, Kevin Winders. Des Smith & Paul Pope | Reserve Development |
| 27 November 2017 | TRBCCC Newsletter | Community Update |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

| 2018 | | |
|-------------------|---|---|
| 22 February 2018 | Tom Dyer & Des Smith | Reserve Development |
| 19 March 2018 | TRBCCC Committee | DCC contribution \$900,000 Reserve |
| 20 March 2018 | Sharn Sutton(ORC) & Des Smith | Project funding |
| 27 March 2018 | Port Otago Seminar on Harbour Environment | Des Smith & Graeme McLean |
| 10 April 2018 | TRBCCC Committee with Kevin Winders PO | Project discussion |
| 23 April 2018 | Working Party Meeting at Marae – DCC, PO, OCB, Rununga, TRBCCC | Project Group – leading to consent |
| 28 May 2018 | Working Party Meeting at Marae | Progressing Project |
| 31 May 2018 | Press Release | Community Update |
| 4 June 2018 | DROP IN SESSION AT MARAE – DCC & PO | Good attendance and support |
| 25 June 2018 | Working Party Meeting at DCC | Project Group |
| 27 August 2018 | Working Party Meeting | Project Group |
| 26 September 2018 | DROP IN SESSION AT MARAE – DCC & PO | Good attendance and support |
| 16 October 2018 | Working Party Meeting | Project Group |
| 16 October 2018 | TRBCCC Meeting | Report back. Prepare public meeting. |
| 22 October 2018 | Public Meeting at 960 Harington Point Road with Kevin Winders PO, Rachael Eaton and team from DCC | Around 70 attended. Community BBQ followed. |
| 26 November 2018 | Working Party Meeting | Project Group |
| 2019 | | |
| 16 March 2019 | TRBCCC Meeting | General |
| 26 March 2019 | Working Party Meeting | Project Group |
| 2 April 2019 | Des Smith & Kevin Winders met with David Williams | Trust Land Representative |
| 6 May 2019 | Working Party Meeting | Project Group |
| 8 July 2019 | Working Party Meeting | Project Group |
| 15 July 2019 | TRBCCC Newsletter | Community Update |
| 3 September 2019 | Working Party Meeting | Project Group |
| 7 October 2019 | Working Party Meeting | Project Group |

Te Rauone Beach Coast Care Committee - Meetings/Consultations 2008-2019

To whom it may concern

I would like it noted that there are many other meetings that have taken place which have not been recorded. Literally hundreds of phone calls have been made to progress this project over the past five years since the new Committee was formed. We have networked far and wide with the many groups that we believe have an interest in this project and have received very positive responses. In terms of the Public Consultation we have recorded many consultations but have not mentioned the numerous articles written by the Otago Peninsula Community Board Chairperson in the Portobello Booklet Newsletter that is published every two months and which is widely distributed.

Trust this is of assistance.

Des Smith

On behalf of the TRBCCC

29 November 2019

GHD
Level 1
104 Spring Street
TAURANGA 3110

Attention: Lezel Botha

Resource Consent – Port Otago Ltd

Proposal

Te Rūnanga o Ōtākou understand that Port Otago Ltd are applying for:

- Applications associated with the construction of 3 x groynes and sand re-nourishment – Te Rauone Beach, Dunedin (as specified in the information provided)

Situation

Aukaha writes this report on behalf of Te Rūnanga o Ōtākou, the kaitiaki Rūnanga whose takiwā includes the site the application relates to.

Decision

Rūnaka representatives have been informed of the proposal outlined in the application received 4 November 2019. Please be advised that Te Rūnanga o Ōtākou do not oppose the application proceeding by non-notified resource consent process, subject to the following condition:-

1. That all work is undertaken at low tide as much as is possible.
2. That all machinery is clean and well maintained prior to entering the work site.
3. That any rock used for the proposed work is clean and placed rather than dumped into position.
4. That machinery only enters the waterway for the extent necessary, to carry out as much of the proposed works as possible, using one corridor for entering and exiting.
5. That monitoring results be forwarded to Te Rūnanga o Ōtākou.
6. That Te Rūnanga o Ōtākou are notified of any maintenance work undertaken at Te Rauone Beach.
7. That the Heritage New Zealand Pouhere Taonga Archaeological Discovery Protocol (attached) should be adhered to

It is understood that the monitoring regime will include :-

- the overall health of the benthic communities with sampling undertaken at regular intervals over 5 years following the completion of the works. The monitoring will also include an additional survey 6 months after any sand/sediment top up that occurs at Te Rauone Beach.

Please see Kāi Tahu ki Otago Natural Resource Management Plan 2005 appendices seen as relevant to this application.

This reply is specific to the above proposal. Any changes to the application will require further consultation.

Aukaha request that the Council forward a copy of the recommending report, and if issued, a copy of the consent.

Nāku noa, nā



Tania Richardson
Consents Officer

cc Te Rūnanga o Ōtākou



Appendices

The following Issues/Objectives/Policies of the Kāi Tahu ki Otago Natural Resource Management Plan 2005 are seen as relevant to the above proposal. This relates to the holistic management of natural resources from the perspective of local iwi.

Kāi Tahu ki Otago Natural Resource Management Plan 2005

Otago Region / Te Rohe o Otago

Wai Māori

Wai Māori General Issues

River and Instream Works

- Introduction of exotic weeds through poorly cleaned machinery, and the subsequent impact on bank habitat and water ecosystems.

Wai Māori General Objectives

- Contaminants being discharged directly or indirectly to water are reduced.

Wai Māori General Policies

- To protect and restore the mauri of all water.

River and Instream Works

- To require that fish passage is provided for at all times, both upstream and downstream.
- To oppose all river and instream work if near a nohoaka site during the months of August to April.
- To require that buffer zones are established and agreed upon with the Papatipu Rūnaka between the flowing water and the site of any river or instream work.
- To require that any visual impacts at the site of the activity are minimal.
- To require that wet concrete does not enter the active flow channels.
- To require that any works be undertaken either before or after spawning season of potentially affected species as identified by the Papatipu Rūnaka.
- To require that all practical measures are undertaken to minimise sedimentation or discharge of sedimentation.
- To require that all practical measures are undertaken to minimise the risk of contamination to the waterway.
- To require that work is done when the water level is naturally low or dry, to carry out as much of the work as possible, using one corridor for entering and exiting.
- To discourage machinery operating in flowing water.
- To require that all machinery is clean and well maintained before entering the work site; refuelling is to be done away from the waterway.

Wāhi Tapu

Wāhi Tapu General Issues

- The resurfacing of kōiwi takata through natural and human-induced processes.

Wāhi Tahu Objectives

- All wāhi tapu are protected from inappropriate activities
- Kāi Tahu ki Otago have access to wāhi tapu.
- Wāhi tapu throughout the Otago region are protected in a culturally appropriate manner.

Wāhi Tapu General Policies

- To require consultation with KTKO for activities that has the potential to affect wāhi tapu.

Otago Harbour Catchments

Wai Māori and Wai Tai

Wai Māori and Wai Tai Issues

- Deterioration of inlet health and impacts on the mauri and life supporting capacity of the sea.

Wai Māori and Wai Tai Policies

- To promote best practise methods for waterways, rivers and harbour works that:
 - Provide for fish passage at all times.
 - Minimise sedimentation during proposed works.
 - Minimise the risk of contaminants entering any waterway.

Coastal Environment / Te Taiao O Te Takutai

Taku Tai Moana Me Wai Māori Issues

- Reclamation has a negative impact on water quality and flow in enclosed harbours and estuarine ecosystems
- Land use activities adjoining the coast adversely affect localized coastal water quality, for example from devegetation and poor riparian management.

Taku Tai Moana Me Wai Māori Objectives

- The spiritual and cultural significance of taku tai moana me te wai maori is recognised in all management of the coastal environment.

Taku Tai Moana Me Wai Māori Policies

- To encourage the integrated management of the coastal environment
- To discourage any further reclamation within the coastal environment

Wāhi Tapu o te Taku Tai Moana

Wāhi Tapu Issues

- Protection of :-
 - The abode of takaroa
 - Water burial sites
 - Coastal caves
 - Umu takata
 - Urupa from erosion, subdivision and walkways

Wāhi Tapu Objectives

- Wahi tapu are protected from inappropriate activities
- Kāi Tahu ki Otago access to sites and species of significance is protected

Wāhi Tapu Policies

- To require an accidental discovery protocol for any disturbance to the coastal marine environment



Te Rūnanga o Ōtākou Inc

45 Tamatea Road
Ōtākou RD2
Otago Peninsula
Dunedin 9077
New Zealand

Thursday, November 21, 2019

Re: Te Rauone Beach Coast Care Committee

Tēnā koe,

I write on behalf of Te Rūnanga o Ōtākou to support Te Rauone Beach Coast Care Committees endeavors to fundraise for the Rock Groynes and Sand Nourishment Project.

The Rūnanga has a long and close association with Te Rauone beach. Historically the beach was the location of several old and large villages and a number of events that occurred on the beach itself have been remembered and passed down through oral traditions. A number of whānau who affiliate to the Rūnanga continue to live in very close proximity to Te Rauone since the Crown grants to the Ōtākou Native Reserve in the 1860's. A portion was reserved from the original land sale of the Otago Block to provide for and sustain future generations.

The beach is still of considerable importance to the Rūnanga and its whānau – tūaki (cockles) gathered from Te Rauone are presented as a delicacy to manuhiri at Ōtākou Marae – a tradition that reinforces the mana of the people of Ōtākou. The Rūnanga has a very deep spiritual connection to the beach; the erosion and its effects upon our whānau to carry out their everyday and traditional practices are of huge concern.

The tremendous effort being made by the Te Rauone Beach Coast Care Committee towards realising the Rock Groynes and Sand Nourishment Project is to be applauded. Te Rūnanga o Ōtākou supports the committee wholeheartedly.

If I can be of any further assistance please do not hesitate to contact me.

No reira
Nāhaku noa, nā

Michelle Taiaroa-McDonald
Manager



NATHAN MCNALLY
Manager

Mailing address

Otago Peninsula Biodiversity Group
PO Box 11
Portobello
Dunedin 9048
New Zealand

T + 64 21 987 332
E manager@opbg.nz
www.predatorfreepeninsula.org.nz

21st November 2019

To whom it may concern

Letter of Support for Te Rauone Beach Coast Care Committee: Rock groynes, sand nourishment and reserve project.

It is with pleasure that I write a letter of support on behalf of the Otago Peninsula Biodiversity Group (OPBG) for the Te Rauone Beach Coast Care Committee and their "Rock groynes, sand nourishment and reserve project".

Since 2008, the Otago Peninsula Biodiversity Group (OPBG) has worked on enhancing the Otago Peninsula's natural environment for people and indigenous wildlife. Through partnerships and community participation, we deliver peninsula-wide animal pest control to restore the resilience of ecosystems and provide a healthy quality of life for all.

This restoration project proposed by Te Rauone Beach Coast Care Committee will serve to protect an area that's important culturally, home to a small community, used for recreation and kai gathering for the wider Peninsula and Dunedin community and is also habitat for a variety coastal species.

The OPBG supports the efforts of the Te Rauone Beach Coast Care Committee and wishes them success with their project.

Yours faithfully

Nathan McNally



OTAGO PENINSULA COMMUNITY BOARD

50 The Octagon | Dunedin 9015 | PO Box 5045 | Dunedin 9054 | New Zealand
E dcc@dcc.govt.nz P +64 3 477 4000 www.dunedin.govt.nz

20 November 2019

To Whom It May Concern

LETTER OF SUPPORT - TE RAUONE GROVNE AND BEACH RENOURISHMENT PROJECT, OTAGO PENINSULA

On behalf of the Otago Peninsula Community Board, this letter is in support of the Te Rauone Beach Coast Care Committee and Port Otago for the Te Rauone Beach renourishment project.

This project has been a very long time in the planning, the community and the Beach Care Committee have worked tirelessly with Port Otago to see it to fruition. The Otago Peninsula Community Board has supported all stakeholders in the consultation and development process of this project.

The Board commends the hard work and dedication of all concerned in this venture and look forward to the beginning of this major project in our community.

Yours sincerely

Paul Pope
Chairperson
Otago Peninsula Community Board



430 Portobello Road
P.O Box 492
Dunedin 9054
New Zealand
64 3 476 1775
info@otagopeninsulatrust.co.nz
www.albatross.org.nz

Wednesday, 20th November 2019

To whom it may concern.

Re: Te Rauone Beach Rock Groynes and sand nourishment project

For over 50 years, the Otago Peninsula Trust (as the name suggests) ,has had a significant history of initiating and supporting environmentally sustainable projects on the Otago Peninsula. The objects of the trust, in summary, are to protect and enhance the environment and amenity values of this unique and beautiful area.

The Otago Peninsula Trust fully supports the vision of this project which is to re-instate a safe and accessible beach amenity that can be used and enjoyed by all members of the areas diverse community.

As the result of a thorough consultation process among the relevant parties (Port Otago Ltd, Te Rauone beach Coast Care Committee, Dunedin city Council, Te Rauone Incorporated and the local community) a solution involving three major steps has been identified and agreed:

- Construction of rock groynes
- Reinstatement of sand
- Planting of suitable species to retain the sand

The Otago Peninsula Trust unequivocally supports this solution and the fundraising efforts of the Te Rauone Beach Coast Care committee and the other groups working to bring it to fruition. We wish them every success in their endeavours.

Yours sincerely

A handwritten signature in black ink, appearing to read "Robyn McDonald", written over a large, light-colored circular mark.

Robyn McDonald

CEO

Otago Peninsula Trust



21 November 2019

Enterprise Dunedin would like to express its support for the Te Rauone Beach Rock Groyne and Sand Nourishment Project.

We wholeheartedly support their project to re-instate the beach amenity and applaud the Te Rauone Beach Coast Care Committee's commitment to this area for all stakeholders.

This project is complementary to the vision and strategies of Dunedin city and would provide economic, social and environmental benefits to the city.

The Dunedin City Council's vision is "Dunedin is one of the world's great small cities". Our six strategic directions support this vision:

- A liveable city;
- An environmentally sustainable and resilient city;
- A memorable and distinctive city;
- A vibrant and exciting city;
- An accessible and connected city; and
- A city that enables a prosperous and diverse economy

The Dunedin Economic Development Strategy 2013-2023 recognises the importance of Dunedin as a compelling destination for visitors "This means providing a quality and attractive build environment, protecting our natural environment and providing exciting cultural sporting and recreational activities and venues".

The Te Rauone area is of prime importance to the Dunedin visitor offering as it provides amenity and access to the Taiaroa Head/Pukekura visitor attractions. The albatross and penguins are key Dunedin icons and vital contributors to the local economy. The presence of wildlife on the Otago Peninsula attracts travellers to the city, which provides growing employment opportunities and increases local expenditure on accommodation, food and so on.

Enterprise Dunedin is fully supportive of the Te Rauone Beach initiatives and in particular recognises that this project will have significant benefits for both the visitor economy and for Dunedin resident's amenities.

Yours sincerely

John Christie
ENTERPRISE DUNEDIN
DUNEDIN CITY COUNCIL



25 November 2019

Mr Des Smith
Chairperson
Te Rauone Beach Coast Care Committee

Dear Mr Smith

Harington Point Rock Groyne and Beach Replenishment Project

We are writing on behalf of Te Rauone Incorporation to confirm Te Rauone Incorporation's support for the Harington Point Beach Rock Groyne project.

At Te Rauone Incorporation meetings, we discussed widely the endeavours of the community through your committee members' hard work and expertise, together with the significant resource and contribution of Port Otago and our understanding the DCC continues to commit financially to the project. It was decided to continue to give the project our full support and backing. Te Rauone Incorporation is supportive of the measures proposed and considers them a vital effort to protect the Te Rauone Beach and Harington Point land. In providing our full backing for the project we are supporting the Te Rauone Incorporation shareholders and the 50 plus lessees/cribholders occupying the Te Rauone Incorporation land at Harington Point.

In addition to lending our support to the project, we have also decided to provide a monetary contribution. We have committed \$15,000 to the project on the condition the project will be seen through to completion by Port Otago. We confirm payment of \$15,000 to be made in the first year of the project commencing, with a further payment of the same to be made in the following financial year.

We trust this information is of assistance as you and your committee continue with your important work to secure funding, to ensure the Harington Point Rock Groyne and Beach Replenishment Project is able to proceed to completion. Should you require further detail or wish to meet as matters progress, please do not hesitate to contact us.

Your sincerely



Julz Asher
Deputy Chairperson
Te Rauone Incorporation



Kevin O'Sullivan
Perpetual Trust Limited
Administrator for Te Rauone Incorporation
(03) 955 3778
kevin.osullivan@pgtrust.co.nz
erin.taylor@pgtrust.co.nz

648 Portobello Rd
Broad Bay
Dunedin 9014

28 November 2019

To Whom It May Concern

Te Rauone Beach Project

The Te Rauone Beach Project involves establishing rock groynes and the restoration of an Otago Peninsula beach, as well improvements to the reserve area which sits alongside an important transport link, connecting an iconic Dunedin attraction with the city.

This project has been a top priority for the community during my three years serving on Dunedin City Council and previously, during my nine years on the Otago Peninsula Community Board, but for the community it has been a priority project for over forty years.

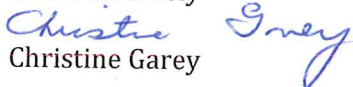
The Te Rauone Beach Project not only addresses the considerable erosion issues at Te Rauone Beach, but it also improves the public amenity of the adjacent reserve, used by the wider community and visitors. Even before I was resident of the Otago Peninsula, I brought groups from the city to use this attractive beachside picnic ground. However, in the intervening years, the erosion has caused considerable damage to the area and this has been especially dramatic in recent times.

My previous letter of support as Chair of the Otago Peninsula Community Board, is dated 2014 and for five years the lodging of the consent application prior to Christmas, has seemed tantalising close. Prior to this year end however, I understand the consent will finally be lodged. This milestone is testament to the extraordinary patience of the community and those leading the project – the Te Rauone Beach Coast Care Committee, and all parties involved, including mana whenua, that considerable progress has been made in recent times.

The DCC is making significant investment in the reserve and Port Otago in the rock groynes, beach restoration and associated work. Both parties have worked closely together with the Te Rauone Beach Coast Care Committee who have driven the project from the beginning. I commend this community group of volunteers for their commitment to the project over many years, their patience and their professional approach throughout this lengthy process.

I wholeheartedly support this important project for the local and wider Dunedin community. The granting of the consent and funding support will enable this long awaited project to begin. I very much look forward to celebrating with the Te Rauone Beach Coast Care Committee and the community on the completion in the near future, of the Te Rauone Beach Project.

Yours sincerely


Christine Garey

20/11/2019

I am writing to add my support to this very important project.

I grew up locally, living at Taiaroa Heads and commencing my schooling at Otakou in 1956.

Over the years I have maintained my interest in this important historic and beautiful place.

It deserves to be maintained and restored.

This worthwhile Project will add significantly to the region, it will be a project that we will all be very proud of.

Regards and best wishes.

Ron Anderson

17 February 2020


Andy Pullar
Port Otago Limited
15 Beach Street
Port Chalmers Dunedin 9023

Dear Andy,

I am the lease holder of the property at 957 Harrington Point Road. The property I lease from the Te Rauone Incorporation adjoins the existing seawall located at the northern point of Te Rauone Beach, Dunedin. I'm writing to inform you I am fully in support of Port Otago's proposal to reduce the erosion issue at Te Rauone Beach through the construction of rock groynes and deposition of sand along the beach. This includes the attachment of the northern most rock groyne to the rock wall that adjoins my property.

Yours sincerely,

Ray Owens


X Ray Owens

Appendix J – Photomontages



Location Plan



View A - (Low tide) Existing



View A (Low tide) with groynes.



View A (High tide) with groynes and sand.



View B - (Low tide) Existing.



View B - (Low tide) with groynes.



View B - (High tide) with groynes and sand.



Channel View - (Low tide) Existing



Channel View - (Low tide) with groynes and sand.

GHD

Level 3, GHD Centre
27 Napier Street


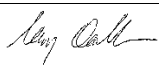
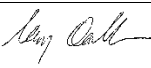
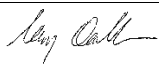
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