Assessment of Effects on Marine Ecological Values

Stage 1 and 2 Stella Passage Development

14 April 2025

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Bibliographic reference for citation: Boffa Miskell Limited 2025. *Assessment of Effects on Marine Ecological Values: Stage 1 and 2 Stella Passage Development*. Report prepared by Boffa Miskell Limited for Port of Tauranga Limited.		
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Status: FINAL	Revision / version: 4	Issue date: 14 April 2025
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Template revision: 20230505 0000

File ref: Sharon De Luca - Marine Ecology Assessment FINAL 14042025.docx

Executive Summary

This report assesses the potential effects of Port of Tauranga Limited's (POTL) Stella Passage project on marine ecology values, and it draws on previous relevant work including project-specific reporting prepared in previous proceedings, other scientific literature and reports.

The ecological values of marine soft benthic shore, hard shores (including rock revetment, wharf structures, and rocky reef), pelagic habitat beneath wharves, and marine vegetation have formed the basis of the assessment.

The range of potential effects assessed on marine ecological values include:

- Effects on coastal processes.
- Increased concentration of total suspended sediment (TSS) (including assessment of resuspended contaminated sediment) during dredging, reclamation and installation of permanent structures.
- Permanent loss of benthic Coastal Marine Area (CMA) due to reclamation and permanent occupation.
- The mortality and disturbance of benthic invertebrates within the areas of reclamation, permanent occupation and dredging.
- The shading of the pelagic CMA by wharf structures.
- Underwater noise and vibration during piling activities and dredging operations.
- Cumulative effects.

The adverse effects on marine ecological values identified (Section 7.1) range from Low to Very Low levels of effect following management measures.

CONTENTS

1.0 Introduction

1.1 Port of Tauranga History

The Port of Tauranga Limited's (POTL) has carried out channel dredging and reclamation to enable the creation of wharves. Dredging to deepen and widen shipping channels was carried out in 1991-1992 and capital dredging was required to deepen the main channel and widen Maunganui Roads in 2015-2016 (Port of Tauranga, 2020).

Historical reclamation for the POTL (and its' predecessors) has involved 69.7ha at Sulphur Point, and 36 ha adjacent to the Mount Maunganui side of the southern harbour (Appendix 1).

Historical capital dredging for the POTL (and its predecessors) has involved 24.5 Mm3[1] of which 5.5 Mm^3 was dredged from Maunganui Roads to Stella Passage between 1970 and 1989[1] and 0.784 Mm^3 removed from Stella Passage during 2015/16.

Typically, the POTL carries out maintenance dredging annually removing around 180,000 m^3 of sediment averaged over the past 4 years.

Historical maintenance dredging has occurred at the Entrance Channel, No. 2 Reach, Cutter Channel, Maunganui Roads, and Stella Passage from 1988 to current, of which Stella Passage maintenance dredging was approximately 745,500m^3 since 1996.

Permanent occupation of the benthic marine environment is currently 1,050 m^2 at the Mount Wharf, and 415 m^2 at the Sulphur Point Wharf.

The existing area of shading beneath wharves and structures are 19,910 m^2 for Sulphur Point and 29,138 m^2 for Mount Maunganui.

1.2 Stella Passage Project

The current proposal is for 10.55 ha (or 1.5 Mm^3) capital dredging in Stella Passage. Maximum annual averaged maintenance dredging currently proposed in reconsenting (2024/2025) is 225,000m^3.

The current proposal also involves 3.58 ha of additional reclamation, being 1.77 ha at the Mount Maunganui (eastern) side of the harbour and 1.81 ha at the Sulphur Point (western) side.

The additional benthic habitat permanently occupied by piles for wharf and dolphins (and some ancillary structures) is 420 m^2 at Mount Wharf and 397 m^2 for the Sulphur Point wharf[2].

[1] Data provided by Rowan Johnstone of POTL. Data was not available for the 1953 work (deepen 7m-8m, 90m wide, from NW rock in a NE direction to approx. N Rock, plus a small amount at Town Wharf (not part of Port footprint) nor between 1988 to 1996.

[3] Information from the Construction Methodology Report (2024). Total 0.08ha.

The new wharf extensions will add a further 12,975 m^2 of shaded habitat at Sulphur Point and 11,716 m^2 of shaded habitat at Mount Wharf (including dolphins[2]). The new Butters Landing minor structures will add a further 162 m^2 to the areas shaded[2].

POTL is preparing an application for Stage 1 and Stage 2 of the development of the Stella Passage and wharves including the activities outlines in Table 1.

Table 1: Proposed activity by Stage (Mount Maunganui Wharves (= MM), Sulphur Point Wharves (= SP)

Proposed Activity	**Stage 1**	**Stage 2**	**Total**
Dredging	6.1 Ha	4.45 Ha	10,55 Ha
Reclamation	0.88 Ha (SP)	0.93 Ha (SP) 1.77 Ha (MM)	3.58 Ha
Wharf Extension MM	-	315 m	315 m
Area of permanent MM occupation	-	322 m^2	322 m^2
Area of Shading MM	-	10,616 m^2	10,616 m^2
Wharf Extension SP	285 m	100 m	385 m
Area of permanent occupation SP	291 m^2	105 m^2	396 m^2
Area of Shading SP	9,605 m^2	3,370 m^2	12,975 m^2
Mooring and breasting dolphins			
Area of permanent occupation by dolphins	-	92 m^2	90 m^2
Area of shading by dolphins	-	1,100 m^2	1,100 m^2
Butters Landing	-	162 m^2	162 m^2
Jetty occupation	-	5 m^2	5 m^2
Penguin ramp occupation	-	1 m^2	1 m^2

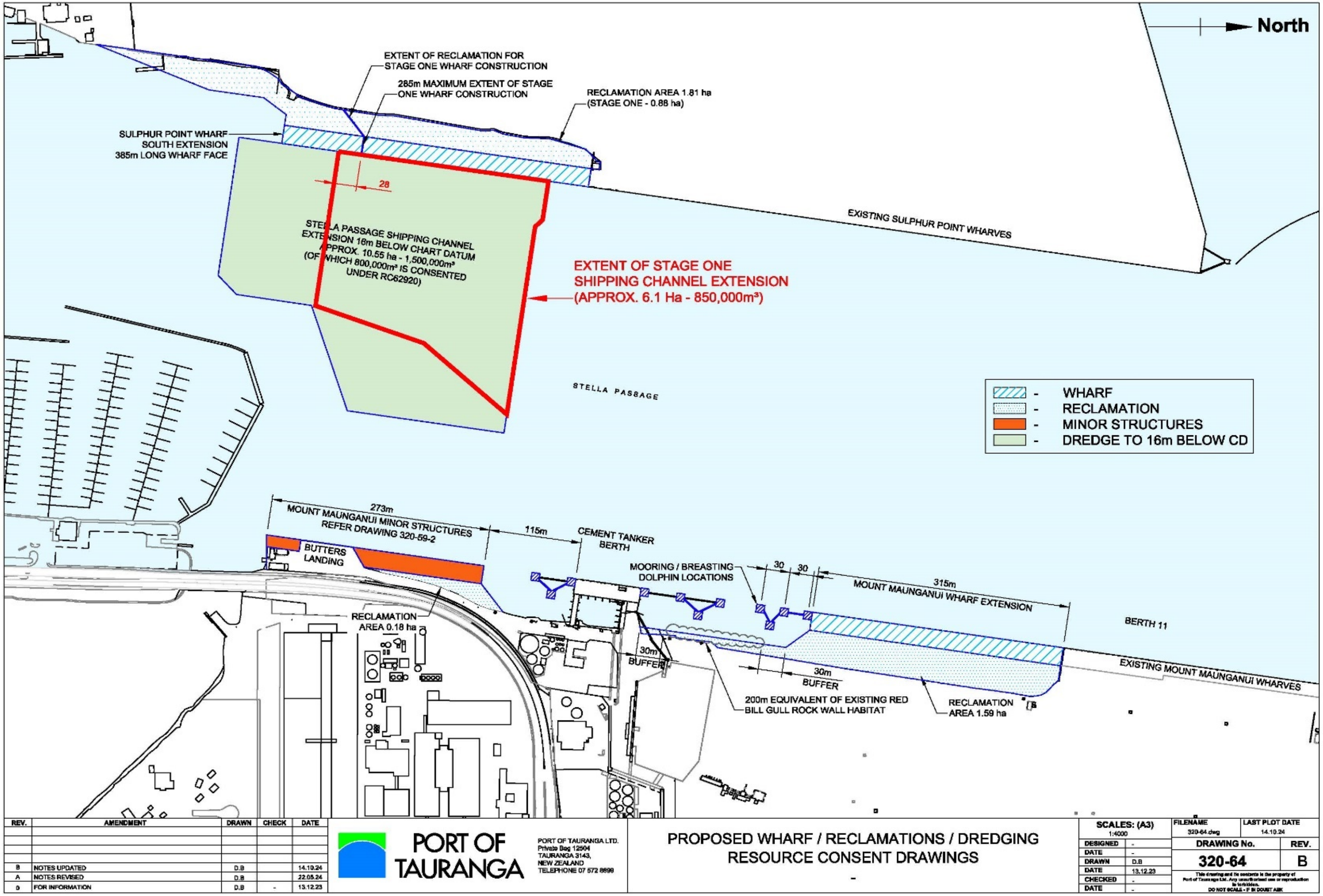

Figure 1: Stella Passage Project

The scope of this report is to assess the effects of POTL of the entirety of the Stella Passage development in the southern harbour of Te Awanui / Tauranga Harbour (Figure 1).

This report summarises the most recent data collected for the 2023 Stella Passage Environment Court hearing, Bay of Plenty Regional Council monitoring data, and recent marine surveys carried out primarily by Boffa Miskell Ltd (BML) for POTL to inform my assessment of the existing marine ecological values.

The areas of marine ecology covered in this assessment include sandy soft sediment habitats outside of the harbour, Stella Passage soft benthic shore, hard shore (reefs, wharves, and riprap), Te Paritaha pipi and sediment, reef and soft sediment kaimoana, marine vegetation, fish, invasive species and disposal sites.

Other experts relied on this assessment are as follows:

- Hydrodynamic Modelling and Sedimentation (Dr Willem de Lange), and
- Marine mammals - Ms Helen McConnell.

2.0 The Proposed Methodology[3]

Extension of Mount Maunganui Wharves by 315 m in length will involve permanent occupation[4] of 322 m^2 of the seabed by piles, and an area of marine environment shading from the wharf extension of 10,616 m^2 (Table 1).

The proposed Sulphur Point Wharf extension is 385 m long (Stage 1: 285 m and Stage 2: 100 m). The areas of permanent occupation[5] by piles is 291 m^2 for Stage 1 and 105 m^2 for Stage 2. The areas of shaded marine environment will be 9,605 m^2 for Stage 1 and 3,370 m^2 for Stage 2) (Table 1).

The installation of mooring and breasting dolphins will require the occupation[6] of 92 $m^2$of seabed by piles. The surface water area occupied by mooring and breasting dolphins will be 1,100 m^2. The development at Butters Landing, will involve a new jetty area with piles occupying[7] 5 m^2 of seabed and shaded area of 162m^2. In addition, a penguin ramp will be installed, occupying 1 m^2 of seabed with piles[8] and resulting in the shading of 18 m^2 of seabed (Table 1).

The general structural arrangement of the proposed wharf extensions will be similar to that used most recently at Sulphur Point in 2013. Being recently constructed, it serves as a relevant example of the type of structural form Engineers and Contractors are combining to produce earthquake resistant designs through modern construction techniques.

The majority of wharf structures at the Port of Tauranga have been constructed using driven pre-stressed concrete piles and pre-stressed deck planks, with cast in-situ pile caps, deck and front beam. However, more recently with technological advances in formwork and the reduced cost of large diameter steel tubes, wharf construction has shifted to driven steel tubes topped with cast in-situ reinforced concrete decks. This is the method proposed for the Sulphur Point and Mount Maunganui wharf extensions.

<u>Wharf Extension Construction Sequence</u>

The time for construction of each wharf extension will be dependent on the length as the construction is a repetitive process, typically starting from one end and constructing sections approximately 20 m in length along the wharf. The 170 m Sulphur Point northern extension completed in 2013 took approximately 12 months for the physical works. On that basis, the Sulphur Point wharf extensions may take approximately two years to complete, with the Mount Maunganui wharf extensions taking approximately three years[9].

A summary of the wharf construction sequence is provided below:

1. Contractor to establish on site;

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[3] Information from the Construction Methodology Report (2024). Total 0.08ha.

[4] Number of piles 464, diameter 0.94m^2.

[5] Stage 1 420 piles of diameter 0.94m^2: Stage 2, 152 piles of 0.94m^2 diameter.

[6] 12 piles per dolphin = 92m^2 occupation).

[7] Jetty six piles 0.8m^2, penguin ramp 4 piles 0.5m^2.

[8] 4 piles at 0.5m^2

[9] Rowan Johnstone pers comm.16/09/2024

2. Dredge/excavate/form the revetment slope;
3. Construct temporary staging platform for cranes;
4. Perform piling works;
5. Place rock armour on revetment slope;
6. Formwork for deck suspended off piles;
7. Concrete deck formed;
8. Rear retaining walls panels installed;
9. Backfill behind retaining wall panels to form reclamation; and
10. Install wharf furniture.

<u>Wharves Revetment Slopes</u>

The constructed wharves will have a finished depth alongside of 16m below Chart Datum (CD) and a batter slope of approximately 1.75(H) to 1(V). The final slope of the embankment will be determined by detailed site-specific design considering multiple serviceability and ultimate load combinations, including the resulting stability during and following an earthquake.

The rock armouring of the revetment slope will be sized to accommodate the environmental conditions, wave and tide and the forces exerted by the bow thrusters of the ships that will berth alongside the wharf. The design ship size will complement the limits imposed by the consented harbour channel depths.

The most recent northern wharf extension at Sulphur Point (in 2013) used a 1.5m thick layer of rock armour with a median rock size diameter of 780 mm (with a range in size from 600 mm to 900 mm). The rock armouring at the northern extension at Sulphur Point has proven to perform well with no scour recorded under the wharf.

The shaping of the batter slope is likely to take place using long arm excavators, grabs, sand pumps or a form of suction dredge. The rock armouring of the batter slope will have a layer of small rocks sized to ensure the sands do not migrate through the batter slope armouring.

Geotextile fabric as a base layer can be used with progressively larger rock sizes placed on top to protect the geotextile prior to the armour rock being placed. Rock armouring will be toed into the base of the vessel sitting basin to provide protection against scour/erosion at the toe of the wharf. This will require discrete areas of excavation deeper than 16m below chart datum (CD).

The rock armouring will either be placed by crane and grab or a long reach excavator operating from temporary staging, a barge or land, prior to the deck being poured or using a purpose-built barge to float the material under the wharf before releasing the rock after the deck has been constructed.

<u>Pumping Ashore</u>

Depending on the amount of suitable material that is required to be removed when the revetment slope is trimmed there can be the need for additional fill to complete the reclamation. Trailer Suction Hopper Dredge (TSHD) are commonly used for pump ashore operations which involve the hopper being discharged via pump through a line to shore. If not appropriately controlled the excess water can cause elevated turbidity and require ponds to settle out the suspended particles prior to discharging the excess water to the harbour. Previous similar work has shown that the quality of discharge is mitigated and controlled via an appropriately sized settling pond.

Any dewatering of the material brought ashore will be done to limit increases in turbidity to less than 15 Nephelometric Turbidity Units (NTU) above background levels beyond 250 m from the construction site (with background levels being measured 500 m upstream from the construction site).

The materials excavated and brought ashore will be similar to those previously dredged from the channels and the turbidity controls mirror previous dredging consents. As with the material bought ashore through forming the batter slope, all material brought ashore will be landed behind the construction site so that any resulting discharge will be contained within the construction site. The location of the discharge within the footprint of the construction area will result in any discharge to water occurring in the same area being modified and lessen any detrimental effects to the immediate surrounding area. Material will only be moved and stockpiled once sufficiently dry to not cause further discharge to the environment.

Seawall Modification

The existing seawalls on the edge of the harbour where development is proposed consist of reclaimed sand faced with rock rip rap for scour and erosion protection. Where these seawalls exist behind a proposed wharf they will be covered over by the reclamation behind the wharf.

As the wharf construction will be carried out in stages, new seawalls are required to tie the extent of any extension back to the existing seawall.

It is noted that during construction of seawalls there is disturbance beyond the legal line of reclamation to “found” the seawall on the seabed. With the current water depths along the proposed line of reclamation ranging up to 4m below chart datum, the revetment slope toe would extend up to 10m beyond the toe of the reclamation, increasing the area of benthic disturbance (area of disturbance is 20,977 m^2 (Sulphur Point Wharf) and 18,803 m^2 (Mount Maunganui Wharf)).

2.1.1 Dredging

Dredging of 10.55 ha and 1.5 Mm^3 (Stage 1 6.1 Ha and 0.85 Mm^3 and Stage 2 4.45 Ha and 0.65 Mm^3) is proposed, of which 5.9 ha (800,000 m^3) is already authorised under Resource Consent 62920 and the ecological effects of that component of the dredging have already been considered (Table 1). Therefore, this assessment considers the ecological effects arising from the balance 700,000 m^3 of the total 1.5 Mm^3 of dredging.

The primary immediate adverse effect from dredging is the resulting suspended solids and turbidity. Turbidity is greatly increased if the material has a fine (particularly clay) fraction in it. The degree of turbidity is also a function of the method of dredging and the amount of disturbance or mixing with water.

Dredged material not taken ashore to use in the proposed reclamations will be deposited in the already consented deposition site under RC 65806. de Lange (2024) states that the primary turbidity generated during dredging consists of a near bed plume generated by the draghead as it excavates the seabed and of a surface plume generated by overflow from the dredge hopper.

2.1.2 Revetment

The revetment is formed through excavation and similar to the dredging, has the ability to cause turbidity. The same turbidity limits imposed on the dredging shall be used for the forming of the revetment slope.

The rock material used to armour the batter slope forming the revetment has the ability to cause turbidity. This will be minimised by the use of clean rock[10] material.

2.1.3 Reclamation

The proposed reclamation consists of 0.88 ha (for Stage 1) and 0.93 ha (for Stage 2) south of the existing wharf at Sulphur Point and 1.77 ha at the Mount Maunganui Wharves (as part of Stage 2) (Figure 1).

The forming of the reclamation requires the dewatering of any dredged material brought ashore. The finer siltier material is not suitable for the reclamation. Sand is the preferred material and as such the risk of turbidity is reduced.

Turbidity can be caused at the outfall from the settlement pond used to dewater the sand as it is pumped ashore. The close proximity of the dredged area to the reclamation means the pumping distance is short and therefore less water will be required to lubricate the pump line when transporting the sediment slurry. The drier the pumped slurry is, the less dewatering required and the less discharge required back into the harbour from the settling pond. Furthermore, the use of filter screens in the pond and booms around any outfall are proposed to limit the turbidity.

[10] i.e. no fines

3.0 Spatial Extent / Scale of Assessment

This assessment considers the proposed project effects at the Stella Passage project scale and the southern harbour scale (**Error! Reference source not found.**).

The “southern harbour” is not officially mapped by any authority, but for the purposes of this assessment the southern harbour area has arbitrarily mapped as approximately **3,530 Ha** (**Error! Reference source not found.**) containing the Port of Tauranga and adjacent significant ecological sites (e.g. Te Paritaha pipi bed and the seagrass beds adjacent to Whareroa marae, along the Ōtūmoetai shoreline and within the wider Waipu Estuary. The southern harbour area mapped is approximately 16 % of the whole Te Awanui / Tauranga Harbour (**21,800 Ha**) (**Error! Reference source not found.**).

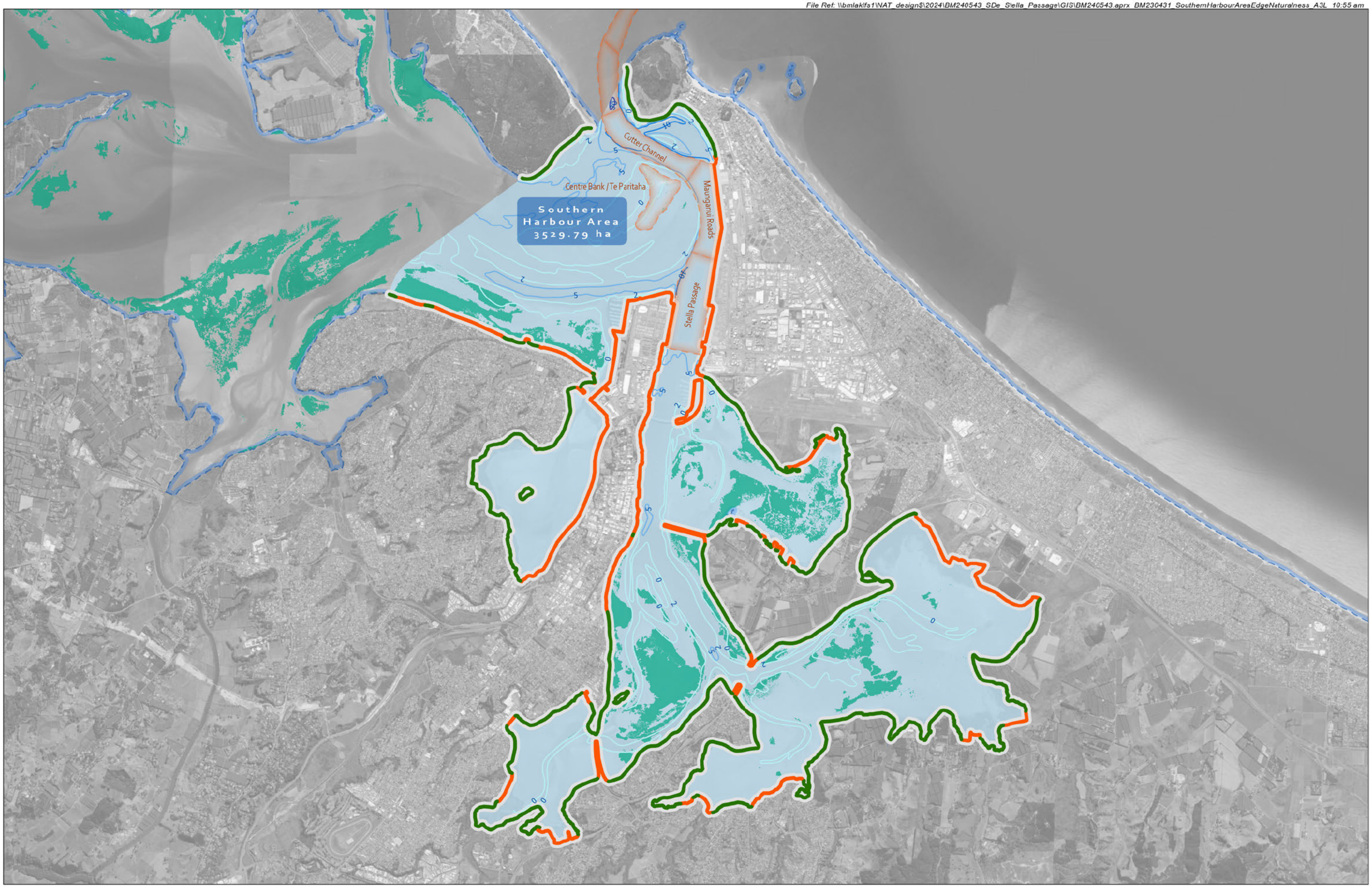
The Stella Passage boundaries are also not officially mapped. The Stella Passage project area is the body of water from Town Reach to the south extending between the Sulphur Point Wharves and Maunganui Roads Wharves up to Cutter Channel (**Error! Reference source not found.**) in the main channel which comprises **112.56 Ha** (see Appendix 2 map from POTL). Stella Passage in this context comprises 0.5 % of the Te Awanui and 3.2 % of the Southern Harbour.

The classification of the existing marine ecological data (Section 4.0) and the assessment of ecological effects if this proposal (Section 7) have been based on the Stella Passage and the Southern Te Awanui scale.

The extent of the Stella Passage works comprises:

- Dredging 10.5 Ha (9.3 % of Stella Passage, 0.3 % of southern harbour and 0.05% of the entire Te Awanui),
- Reclamation / occupation 3.66 Ha (3.3 % of Stella Passage, 0.10 % of the southern harbour and 0.02% of the entire Te Awanui), and
- Shading by wharves and structures over 2.5 Ha (2.2 % of Stella Passage, 0.07 % of the southern harbour and 0.01% of entire Te Awanui)[11].

[11] Whole Te Awanui 21,800 Ha, Southern Harbour 3,530 Ha, Stella Passage project area 112.56 Ha, area of proposed dredging 10.5 Ha, area of reclamation/permanent occupation 3.66 Ha, shading by wharves 2.5 Ha.



Harbour Edge
- Modified (32.2 km)
- Natural (47.5 km)
- Mean High Water (LINZ Coastline)
- Seagrass (2020+)
- Harbour Feature

Bathymetry Tauranga Harbour
Depth (metre)
- 0 - 2
- 3 - 5
- 6 - 10
- 11 - 30
- 31 - 50

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Data Sources: BOPLASS Limited, Maxar, Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors
Projection: NZGD 2000 New Zealand Transverse Mercator

STELLA PASSAGE PROJECT

Southern Harbour Area and Harbour Edge

Date: 12 November 2024 | Revision: B

Plan prepared for Port of Tauranga by Boffa Miskell Limited

Project Manager: [redacted] | Drawn: JWa | Checked: SDe

Figure 2

4.0 Existing Marine Ecology Data/Information

4.1 Marine habitats and species within the southern harbour of Te Awanui

The seabed and shores of the western Bay of Plenty are predominantly soft sediment (sand) with rocky reef comprising approximately only 5 % of the coastline (Graeme, 1995). Leonard et al. (2020) states that the southern harbour is in good health and its biodiversity reflects a typical north-eastern New Zealand temperate harbour ecosystem.

Mauāo marine area is recognised as an Indigenous Biological Diversity Area B (IBDA B64) in the Bay of Plenty Regional Council's (BOPRC) Coastal Environment Plan for the reef around Mauāo as settling areas for juvenile crayfish, pāua and kina and serving as an ecological corridor between Motuotau Island, Motiriki and Mauāo (New Zealand Coastal Policy Statement (NZCPS) Policy 11(b)(vi)). Policy 11(b)(iii) also applies as this reef (Mauāo) is the only coastal rocky reef headland on the mainland between Coromandel Peninsula and Waihau Bay.Mauao,

Moturiki and Motuotau reefs are within the Tauranga Moana Mātaitai Reserve. Annual monitoring of marine taonga species in rocky reef habitats within the Tauranga Moana Mātaitai Reserve is undertaken as part of a collaboration between Port of Tauranga and the Tauranga Moana Iwi Customary Fisheries Trust (TMICFT) (Boffa Miskell Ltd, 2023b) (**Figure *3***).

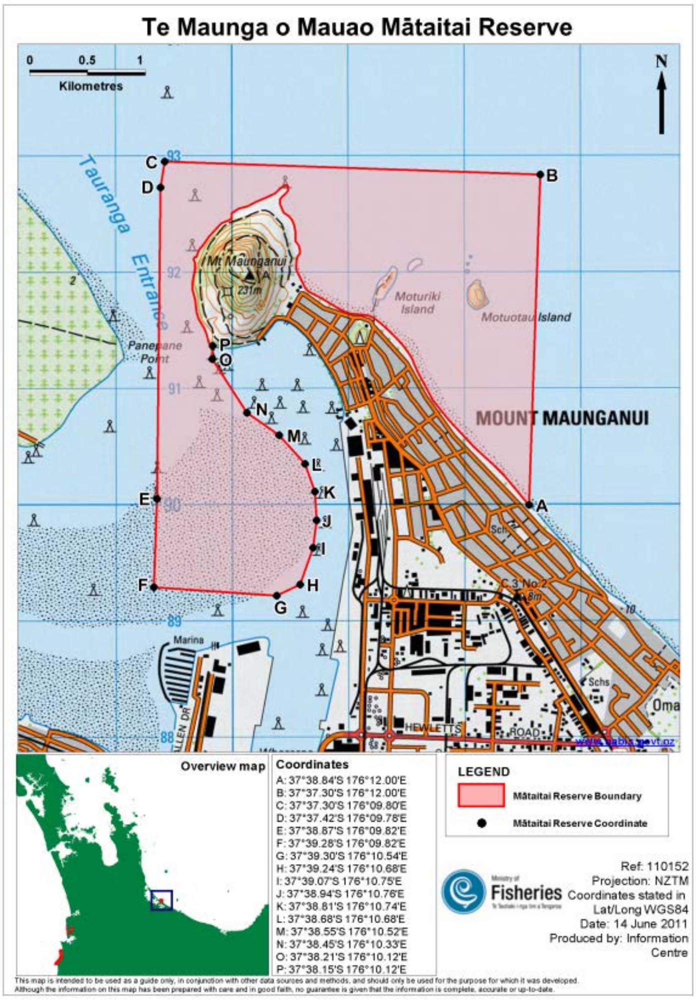

Figure 3: The location of the Te Maunga o Mauao Mātaitai Reserve

Kina, pāua, kōura and kūtai are the main taonga species surveyed based on a mātauranga Māori approach[12] (see Appendix 3).

This report states the marine ecological values of the southern harbour of Te Awanui are high based on assessment of flora and fauna previously collected and newly collected data, reports and evidence on rocky reef communities, soft sediment benthic communities, sediment quality, fish, etc) that are deemed relevant to the POTL and its activities (**Error! Reference source not found.**).

4.2 Stella Passage benthic soft shore habitat

Part of the Stella Passage (Figure 1) has previously been dredged to accommodate ships at Sulphur Point and regularly receives maintenance dredging. The benthic marine communities

[12] Baseline surveys, and therefore the entirety of the Kaimoana Restoration Programme is fundamentally informed by mātauranga Māori whereby semi structured interviews with Tauranga Moana, participating iwi representatives including kaumātua were carried out in 2013 to identify cultural sites of significance in the Tauranga Moana Mātaitai Reserve. Intergenerational mātauranga Māori identified traditional distribution, abundance and sizing of taonga species; kina, kūtai, kōura, pāua and pūpū across all identified sites.

within the dredged area are in a cyclic pattern of recovery, continually reset due to primarily maintenance dredging (Grace, 2010).

Leonard et al. (2020) stated that the marine species' diversity and abundance is characteristic of New Zealand port and harbour organisms and consistent with a temperate New Zealand east coast harbour environment. The marine species assemblages are relatively stable over time despite a number of capital dredging campaigns in the past 10-15 years (Leonard et al. 2020).

Battershill (2022) describes the soft sediment subtidal assemblages to be expected of a healthy harbour environment. Given the historic and proposed dredging, I assess the ecological values of the soft sediment habitats overall to be Moderate, as they are in a state of continually flux / natural recovery.

Grace (2010) found that the benthic invertebrate community in Stella Passage comprised a representative community structure (dominated by a heterogeneous community of typical polychaete worms, bivalves, amphipods, decapods etc, with no rare or threatened species present).

Leonard et al., (2020) collected benthic invertebrates from benthic tows in Stella Passage and found an abundant[13] and diverse[14] community with sensitive and tolerant species. Sensitive species included a range of gastropods, nudibranchs, opisthobranchia[15], bivalves, polychaetes, isopods, barnacles, and sea stars. Tolerant species included a range of gastropods, a bivalve, polychaetes, a species of isopod, two decapod species and brittlestars.

The average Shannon Weiner Diversity Index across the 15 benthic tow sites was 2.1, revealing high diversity. Drift and resident (attached) seaweeds were also diverse (Leonard et al., 2020). The data captured by Leonard et al. (2020) compares well with those of Healy et al. (2009) where 85 taxa were recorded from the same area, and of similar species diversity and that of Grace (2010).

Leonard et al. (2020) states that the Stella Passage channel floor is in good health, as it is dominated by sandy grain sizes, with only a few pockets of fine sediments. There is a shallow layer of oxygenated sediment, with some anoxic conditions experienced in eddy areas associated with wharf structures.

Leonard et al. (2020) characterised the Te Awanui channel floor in the Stella Passage as being reflective of a working port seabed, comprising an ecologically productive benthic community with naturally diverse indigenous native infaunal species. Leonard et al. (2020) stated that most benthic habitats within ports in New Zealand are characterised by fine sediment and dominated by low native biodiversity and a high abundance of exotic species presence, whereas Te Awanui presents sandy sediment and predominantly native marine organisms.

It is anticipated in this assessment that there is similarly high natural variability (heterogeneity) and diversity of benthic organisms in the relatively stable soft sediment subtidal benthic community structure within Stella Passage at present.

4.3 Stella Passage hard shore habitat/ wharf structures

The wharf structures at Mt Maunganui and Sulphur Point have high marine biodiversity (including a range of anemones, barnacles, sponges, seasquirts and hydroids). This biodiversity is partly due to the rapid currents (bringing nutrients) and the range of light levels on the structures at various depths (Battershill, 2022a). Juvenile crayfish are known to settle in the under the wharf structures, moving to the harbour entrance and to the offshore reefs when adults.

Wharf pile habitats comprise a 3-dimensional community. Leonard et al. (2020), in their report for the Stella Passage port development, describe the pile communities having variable layer(s) of dead encrusting organisms (*Balanus decorata, Galeolaria hystrix*) and oyster shells (*Saccostrea glomerata*), with a rich diversity of encrusting invertebrates such as sponges, hydrozoans and anthozoans overlying these organisms. Interspersed amongst these species

[13] Average number of individuals per benthic tow 97, with an average number of taxa of 17

[14] Average Shannon-Wiener Diversity Index 2.3

[15] Bubble shell

are a large variety of encrusting and mobile worms, gastropods, polychaete worms and other invertebrates.

Community composition on the existing wharf piles is diverse with large sponge colonies and mature invertebrate fauna present (Leonard et al. (2020). All pile communities are representative of a complex, healthy estuarine/harbour habitat (Leonard et al., 2020). Pre-dredge and post-dredge pile communities were not observed to be different (including sponges) (Leonard et al., 2020). A single specimen of a recently introduced invasive solitary, subtidal ascidian tunicate (*Styela clava)* was observed on one wharf pile in the Stella Passage assessment. Eighty-eight species have been identified from wharf pile collections indicating a highly biodiverse habitat (Leonard et al., 2020).

Battershill (2022) describes the existing wharf piles in the Stella Passage as having a rich diversity of encrusting organisms (especially sponges and ascidians) that are "representative of a vibrant, healthy estuarine/harbour habitat". My assessment of the hard substrate / wharf pile communities is that the ecological values are Moderate (Table 3).

4.4 Harbour edge modification

Over 32.2 km of the shore edges within the Southern Te Awanui (**Error! Reference source not found.**) have been modified (40 % of total shore edges of the Southern Te Awanui). The proposed extensions to Sulphur Point and Maunganui Road wharves are occurring along already modified edges, without any further modifications of natural harbour edge.

4.5 Sandy subtidal areas inside and outside of the harbour

Clark et al. (2018) was the first comprehensive quantitative survey of Tauranga Harbour's subtidal environment since 1990/91. The Tauranga Harbour subtidal environment was found to be in good condition with most sediment physico-chemical parameters lower than national median values. Upper reaches of the estuarine channels tended to have higher mud, organic matter and nutrient concentrations compared to sites closer to the main channels. Metals were highest in the urbanised southern harbour or in areas of high mud deposition. Compared with 1990/91 data, fewer scallops and horse mussels were observed in 2016 and the invasive Asian date mussel has become common. Overall, subtidal benthic communities appeared to be healthy with regard to mud and metal impacts (Clark et al., 2018). Most subtidal sites ranked in the lower Benthic Health Model (BHM) groups (for macroinvertebrate community), indicating Tauranga Harbour comprises fairly healthy subtidal communities with a "good" ecological ranking (Clark et al. 2018).

The sandy offshore areas outside of the harbour comprise clean mobile sand and naturally sparse marine fauna (the depauperate benthic invertebrate character of this type of habitat is typical on open sandy beaches).

From intertidal beaches to subtidal (approximately 25-30m depth) sand dollars (*Fellaster zelandiae*) and tuatua (*Paphies subtriangulata*) are commonly found along with sparse assemblages of molluscs, crustaceans, decapods and worms. Tuatua (*Paphies subtriangulata*) are often abundant (subject to their natural variability in space and time) in shallow water at low tide.

Beyond 25-30 m depth, the benthic habitat becomes more stable and more muddy (Grace, 2010).

4.6 Centre Bank / Te Paritaha

Te Paritaha intertidal shellbank is a significant kaimoana collecting ground for intertidal pipi (*Paphies australis*) within the Te Maunga o Mauao Mātaitai Reserve (**Figure *3***). Subtidal pipi beds are also present in the Western channel and in the main entrance channel. Juvenile pipi settle on the intertidal sand of Te Paritaha and migrate as adults to the subtidal populations. Monitoring of pipi at Te Paritaha has most recently been conducted by POTL in 2016 (Fairlie et al., 2017), 2022 (Boffa Miskell 2023), 2023 (Boffa Miskell 2024a) and 2024 (Boffa Miskell 2024b and c, 2025a).

Te Paritaha and the pipi resource is a taonga to mana whenua. Various witnesses for tangata whenua (including Te Runganga o Ngāi Te Rangi Iwi Trust, Ngāti Hē and Ngāti Ranginui Incorporated Society and Ngāti Ranginui Fisheries Trust)[16] for other POTL dredging consent hearings have raised concerns about the decline of pipi at Te Paritaha being linked to the POTL dredging. However, this assertion has not been confirmed and there is no scientific data supporting it.

Grace (2010) states that there are substantial subtidal adult pipi beds in the western harbour, in the main entrance channel west of Mauou, and in the harbour entrance gorge.

Fairlie et al. (2017) survey detected a large recruitment of juvenile pipi into Te Paritaha Abundance of adult pipi have been stable in the period preceding and following the 2015 dredging campaign, which supports the conclusion that the dredging did not affect pipi populations at Te Paritaha (Fairlie et al., 2017).

Te Paritaha is an area of Significant Cultural Value (ASCV4a, Bay of Plenty Regional Coastal Environment Plan). Schedule 6 states:

> "*Te Paritaha is said to be the source of mauri for all other pipi beds in Te Awanui. (ASCV 4a. BOPRC Coastal Plan). "The role of whānau hapū and iwi as kaitiaki is to protect the mauri of Paritaha. Mauri in this regard refers to the integrity, form, functioning (including natural biological and ecological processes), resilience, physical and spiritual characteristics & qualities, mana-atua, mana-tangata, tapu life principle, tikanga and kawa practices, connectedness & interdependency and accessibility. This involves ensuring that the full physical extent of the integrity of Paritaha is acknowledged. In this way, the kaimoana that Paritaha supports is also protected".*

Data on the abundance of subtidal pipi collected by Ross & Culliford (2018) on the north-west edge of Te Paritaha pre and post the 2015 dredging, showed good recovery of pipi at all depths sampled. Pipi numbers quickly returned to pre-dredge levels, although there was some spatial change in pipi location along the edge of the bank.

[16] From Environment Court Decision, March 2024, Stella Passage hearing.

Leonard et al. (2020) stated that there is no recent information on the dynamics of pipi beds at Te Paritaha. Subsequently, BML has undertaken intertidal and subtidal pipi surveys at Te Paritaha in 2022, 2023 and 2024 (engaged by the POTL and in collaboration with iwi). These surveys have covered the areas previously sampled by Fairlie et al. (2017) and by Ross & Culliford (2018) and added new survey sites.

BML intertidal surveys in 2022 (Boffa Miskell 2023e) showed that abundances of pipi varied significantly across the area surveyed in the northern half of Te Paritaha. Three sites along the north-eastern portion of the study area had the highest number of pipi averaging 14-18 individuals per core. The lowest abundances of pipi occurred at the southern end of the study area with an average of less than one pipi per core. The majority of the sampling sites averaged 3-7 individuals per core. Most of the pipi were juveniles measuring less than 30 mm in size (indicating a successful recruitment event), except for four adult pipi measuring between 50-58 mm, found on the northernmost point of the area surveyed.

BML also carried out subtidal surveys (in conjunction with Toi Ohomai) for pipi along the north-east edge of Te Paritaha in 2022, with transects extending approximately 15m down the main harbour channel (Boffa Miskell 2023e). Transect locations and lengths were the same as that in Ross & Culliford (2018). Subtidal pipi abundances varied between and within transects, with the highest number of individuals totalling 274 across forty cores along transect B, and the lowest number of individuals recorded along transect A (2 individuals across forty cores). Densities of pipi varied with depth, with higher densities at shallower depths. The average size of pipi was approximately 50 mm, regardless of depth.

Further surveys carried out in 2023 and 2024 (Boffa Miskell 2024a, b,c) confirmed the patterns observed in 2022, with the intertidal area of Te Paritaha dominated by recruit and juvenile pipi, while larger adult individuals were mostly confined to the subtidal habitat.

Details of the 2022-2024 surveys carried out by Boffa Miskell are presented in Appendix 4.

4.7 Tuangi Population adjacent to Whareroa Marae

Iwi have expressed concern over the reduction in average size of tuangi (the cockle *Austrovenus stutchburyi*) adjacent to the Whareroa marae. The size/frequency of tuangi at Whareroa Marae is consistent with other regions within Tauranga Moana. As with all shellfish populations, there are times when juvenile sizes dominate the size frequency due to natural recruitment and growth of shellfish.

Patterns of declining abundance of large individuals have been observed in intertidal populations of both pipi and cockles (*Austrovenus stutchburyi*) across the upper North Island (Berkenbusch et al., 2022; Berkenbusch & Hill-Moana, 2023). The reasons for the general decline of large individuals within northern pipi and cockle populations remain unknown, but are likely to include harvesting pressure, changes in the benthic environment (e.g., grain size and topography of the seabed), adverse weather conditions (particularly unusually hot weather), poor water quality, parasites and bacteria (Berkenbusch et al., 2022; Berkenbusch & Hill-Moana, 2023).

Leonard et al., (2020) surveyed tuangi adjacent to Whareroa Marae (n=30). Cockles near Whareroa Boat ramp were abundant (>90 m^2), with maximum shell length 28 mm, and an average shell length of 18.3 mm. In comparison, cockles were of a smaller average size at sites at Matapihi and Te Puna estuaries (Leonard et al., 2020).

4.8 Marine vegetation

4.8.1 Seaweed

The hard structures in the southern harbour, such as existing rocks and concrete sides, support attached species of macroalgae such as *Ecklonia radiata*, *Ulva* spp, *Codium fragile*, *Hormosira banksii*, *Undaria pinnatifida*[17], *Gracilaria chilensis*, and *Gigartina* spp. (Leonard et al., 2020). Some drifting species such as *Carpophyllum* spp. and *Sargassum sinclarii* also contribute as potential food sources for grazers.

A study of the algae *Hormosira banksii* in Tauranga Harbour by BOPRC (Crawshaw & Shailer, 2023) revealed an increasing cover in the Tauranga Harbour and is related to seagrass habitat. It is unlikely that *H. banksii* expansion is a sign of eutrophication or increased nutrient inputs. The extent of *H banksii* is spatially related to the presence of seagrass (*Zostera muelleri*) in Tauranga Harbour (Crawshaw & Shailer, 2023), where it is likely that the seagrass helps to trap *H. banksii* in place.

Seaweeds/macroalgae are not a dominant habitat feature in the Stella Passage area (but present within adjacent rocky reef habitats), which primarily consists of soft sediment benthic habitat (apart from hard structures such as wharf piles). The high flow of water does not encourage macroalgae to proliferate in the Stella Passage compared to reefs in the outer harbour.

4.8.2 Seagrass

Seagrass is a threatened species (*Zostera muelleri* - At Risk – Declining) (de Lange et al, 2018). The New Zealand Coastal Policy Statement 2010 (NZCPS) requires decision makers to protect indigenous biodiversity in the coastal environment, and avoid, remedy or mitigate adverse effects on habitats in the marine environment, including seagrass (see section 7.2).

Seagrass is a flowering marine plant located in sheltered coastal and estuary ecosystems. Seagrass provides numerous ecosystem services, including habitat, food and nursery areas for a range of fish species (supporting increased biodiversity).

Seagrass is located in the Te Awanui within the areas potentially influenced by the Port activities adjacent to the Whareroa marae, which is upstream of the Tauranga harbour bridge (see **Error! Reference source not found.**) and within the Waipu Estuary and along the Ōtūmoetai shoreline. Small patches on Te Paritaha have been observed in recent years. The seagrass beds present in Te Awanui are the largest remaining seagrass beds in the Bay of Plenty[18]. Between 1990 and 2019, Te Awanui experienced an approximately 50% reduction in seagrass area (seagrass decreased in cover from 2,237 ha to 1,184 ha. These significant losses of seagrass extent have been documented across all major Bay of Plenty estuaries over the past 100 years. A range of human induced stressors may contribute to the loss of seagrass, including eutrophication, sedimentation, turbidity, climate change, storm intensity, as well as waterfowl grazing. Recent assessment indicates some recovery of seagrass extent in Tauranga

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[17] Exotic

[18] Land, Air, Water Aotearoa (LAWA) - Tauranga Harbour

Harbour (including significant areas of subtidal seagrass), whilst declines continue across the smaller estuaries of the Bay of Plenty (Crawshaw et al., 2023).

The key stressors for seagrass requiring management include sediment, nutrients, and the interactive effects of eutrophication (macroalgae growth and limited light availability) (Crawshaw et al., 2023).

Areas of seagrass are present south of the harbour bridge and offshore from Whareroa marae and numerous areas to the south and south-east (Leonard et al., 2020). This seagrass bed adjacent to Whareroa marae is the closest to the Port and it remains in good condition despite the close proximity to the previous dredging campaigns. This seagrass area has been stable over time, despite a decline in the early 1990s which is a feature of all seagrass in Te Awanui and nationally. Seagrass adjacent to Whareroa marae was not impacted by the 2015-2016 capital dredging campaign (Battershill, 2022a).

Battershill (2022a) surveyed seagrass beds adjacent to Whareroa marae in Waipu Bay and other locations in Te Awanui, concluding the beds adjacent to Whareroa marae were stable (after a decline in 1990s) and in good health. However, seagrass beds at Te Puna seemed to be in better condition due to the geophysical location of the Waipu Bay bed which is towards the harbour entrance, whereas other beds are located further into the upper harbour system.

Seagrass is particularly susceptible to elevated turbidity and the deposition of sediment which can reduce seabed light levels impacting primary production (Bulmer, et al., 2018). Leonard et al. (2020) indicated that, overall, the seagrass beds in Te Awanui are in a healthy condition, with variations in coverage, canopy height, shoot length, leaf count, and photosynthetic health among different locations.

The recent 2015 capital dredging involved the removal of 784,051 m^3 from Stella Passage by TSHD and a back-hoe dredge (BHD) of similar material to be encountered for the proposed dredging. The dredging controls used in those works were successful in limiting turbidity by limiting dredging to the out-going tide with limited overflow. The dredging controls for the TSHD proposed for this project are no overflow when dredging on the incoming tide and a maximum of 15 minutes on the outgoing tide. This methodology change is required on this campaign to balance the work across the full tidal spectrum and minimise the duration of the dredging campaign. The TSHD will be fitted with a green valve[19] or similar technology to reduce turbidity caused by any overflow. This will enable protection of seagrass beds, especially adjacent to Whareroa marae.

4.9 Fish and other large mobile species

4.9.1 Fish

Underwater footage (informally collected by POTL in 2011 and 2018 adjacent to the Port wharves at Pilot Bay) revealed a number of mobile species (including fish) such as schools of kingfish (*Seriola lalandi lalandi*), red moki (*Cheilodactylus spectabilis*), yellow moray eel (*Gymnothorax prasinus*), spotty (*Notolabrus celidotus*), triplefin (*Forsterygion lapillum*, *Forsterygion maryannae*, *Grahamina capito* and *Grahamina gymnota*). Other taxa included

[19] The 'green valve' environmental dredging technique developed for TSHDs reduces turbidity caused by overflow during the dredging process.

glass shrimp (*Palaemon affinis*), sea horse (*Hippocampus abdominalis*), lemon nudibranch (*Dendrodoris citrina*), gem nudibranch (*Dendrodoris germacea),* 11 arm star fish (*Coscinasterias muricata*), cushion star (*Patirella regularis*), short tail sting ray (*Bathytoshia brevicaudata*), octopus (*Macroctopus maorum*), yellow moray eel (*Gymnothorax prasinus*), red rock crabs (*Guinusia chabrus*) and crayfish (*Jasus edwardsii*).

A fish survey using Baited Remote Underwater Video (BRUV' was conducted at 4 sites in 2018 and 2019 close to the dredging area but at a distance from ship operations). Fish and ray abundance and diversity was examined amongst the four drop sites (Ōtūmoetai Channel, Bridge Marina, Town Reach and Matapihi) (Leonard et al., 2020). In 2019, Leonard et al., detected kahawai, snapper, kingfish and an eagle ray at Ōtūmoetai Channel, parore, kahawai, yellow-eyed mullet, trevally and an eagle ray at Tauranga Bridge Marina, juvenile snapper at Town Reach, and snapper, trevally and eagle ray at Matapihi site. The species diversity was relatively even, with three ray species and eight fish species detected in 2018 compared to 2019 where there was one ray species and nine fish species detected. Fish counts were higher in 2019 compared to 2018, with juvenile snapper dominated the fish counts in 2019 (Leonard, 2020).

Stella Passage consistently supports species diversity and significant populations of adult fish, particularly kahawai. Species detected in 2019 included eagle ray, snapper, trevally, kingfish, gurnard, kahawai, parore, and spotty (Leonard et al., 2020).

These fish observations are indicative of a consistent and diverse fish population in Te Awanui, with the port area supporting adult fish populations. Recreational fishing is popular, and shark populations suggest a stable pelagic food web (Kellett, 2021)[20].

The active port area provides a suitable habitat for diverse and abundant fish (Leonard et al., 2020). Recreational fishers are often located in the Stella Passage and immediately adjacent to the wharfs/ships indicating suitably sized pelagic and semi-pelagic fish species (Battershill, 2022). Port operations and dredging activity do not appear to influence fish abundance (Battershill, 2022a). In his summation of evidence for the Stella Passage POTL project, Battershill (2022a) states that the active port area supports suitable habitats for a range of fish species, including recreational target species.

4.9.2 Sharks

There are around 73 species of shark found in New Zealand. In Tauranga Harbour the following shark species can occasionally be present; smooth hammerhead (*Sphyrna zygaena*) mangōpare, blue (*Prionace glauca*) mango au pounamu, mako (*Isurus oxyrinchus*) ngutukao , bronze whaler (*Carcharhinus brachyurus*) ngerungeru, thresher (*Alopias vulpinus*) mango ripi and great white (*Carcharodon carcharias*) mango taniwha.

Of these species, only great white shark is Threatened (nationally endangered, qualifiers data poor, threatened overseas) (Duffy et al., 2018). Great white shark are found in coastal waters

[20] A research project on bronze whaler shark use of the harbour showed consistent utilisation by significant populations of these sharks over a 3+ year period, suggesting a long-term structure in the pelagic food web associated with the harbour.

throughout mainland New Zealand and offshore islands with high abundance around Chatham Islands, Southland and Stewart Island[21].

Great white shark are occasionally present in Tauranga Harbour. Battershill (2024) states that Te Awanui is an important habitat and likely nursery for a number of shark species and mentions there has been an unusually high frequency of this species in Tauranga Harbour over the last couple of years coinciding with a major coastal marine heat wave (Battershill, 2024). Given the presence of sharks in Te Awanui, it is apparent that background harbour noise is not a deterrent to this group (Battershill, 2024).

Sharks' hearing range is narrow compared to marine mammals, but they are sensitive to very low frequencies. This hearing range overlaps with most anthropogenic sound produced by dredging, pile driving, and shipping. Noise from these sources can impact the ability of sharks to locate prey and perform other behaviours[22]. Piling noise can impact great white sharks and other shark species by hearing and sensory disruption affecting prey detection, communication and navigation, changes to behaviour (such as feeding and mating) and cause stress (threat to homeostatis)[22] (Chapuis et al., 2019).

The sounds perceptible to sharks are below 1.5kHz and anthropogenic noise in the harbour is typically <2kHz (Battershill, 2024). During dredging and piling it is likely that sharks would avoid the Port area. The bubble curtain around construction will also cause sharks to avoid the proposed development area and associated noise (Battershill, 2024).

4.9.3 Turtles

Green turtle (*Chelonia mydas*) are very occasionally seen in Tauranga Harbour including Stella Passage[23]. They are a migrant, non-resident species. Green turtle are threatened overseas (IUCN ranked endangered) (Hitchmough et al., 2021). They breed in tropical waters where sea temperatures are above 20°C.

There are a number of gaps in the understanding of the effects of underwater noise on turtle (Elliott et al., 2019). Continued exposure to high levels of pervasive anthropogenic noise in important turtle habitats could affect turtle behaviour and ecology (Samuel et al., 2005).

Little is known about effects of underwater noise on turtles. It is likely that would be influenced by construction of the proposed development. However, the occurrence of green turtles in Tauranga Harbour and Stella Passage is rare.

4.9.4 Diadromous fish

Diadromous fish are species that spend part of their lives in freshwater and part in saltwater. Diadromous fish in Waipu Bay and surrounding estuary include short (*Anguilla australis*) and long fin eel (*Anguilla dieffenbachii*) (At Risk – Declining) (tuna).

Shortfin glass and longfin eels migrate into very turbid waters during flood events. High turbidity provides cover for glass eels[24] to migrate during daylight hours rather than just at night. Turbid

[21] NABIS – www.nabis.got.nz

[22] Sharks and Noise: Understanding the impact of underwater noises. www.shunwaste.com

[23] Cross examination of John Heaphy, Stella Passage Environment Court Hearing 2024, transcript pages 1417-1418.

[24] juvenile eel that arrive from the sea at river mouths are known as glass eels, because they are transparent. Between July and December each year, millions arrive from the tropics (Glass eels – Eels – Te Ara Encyclopedia of New Zealand).

waters are unlikely to impede the migration of elvers from coastal areas into adult habitat because elvers do not avoid even extremely high turbidity water in experiments. In some situations, migrating elvers appear to be attracted towards turbid tributaries (Schicker et al., 1990).

Tuna heke is the term that describes mature eels that migrate from freshwater habitats to the sea to spawn completing their life cycle. The journey of tuna starts and ends in the Pacific Ocean near Tonga, where researchers have determined is the most likely destination for their migration from New Zealand to their breeding grounds (Otago Museum, 2020[25]). Downstream eel migrations normally occur at night (when piling not occurring) during the dark phases of the moon and are often triggered by high rainfall and floods (i.e. turbid water). There is a pattern in the sequence of seaward migrations with the smallest, shortfin males migrating during February and March, followed by shortfin females in March and April. Longfin males migrate during April, followed by longfin females from late April to June (Schicker et al., 1990).

From this research, it is clear that tuna are tolerant of, and even prefer, turbid water when inhabiting freshwater environments and also migrating to the ocean as part of their life cycle (Schicker et al., 1990). In addition, migration downstream occurs at night, when piling will not occur. Therefore, avoiding effects on tuna migration from Waipu Bay through Stella Passage to the ocean.

4.10 Invasive species

Since 2002, Te Awanui has been included in the government-funded National Marine High Risk Site Surveillance (NMHRSS) programme. This programme implements surveys every 6 months for a selected suite of target non-indigenous species (NIS) at high-risk sites around the country. The NMHRSS programme is designed to detect the presence of five primary target NIS (*Asterias amurensis, Carcinus maenas, Caulerpa taxifolia, Eriocheir sinensis*, and *Potamocorbula amurensis*) and four secondary target NIS (*Arcuatula senhousia, Eudistoma elongatum, Sabella spallanzanii*, and *Styela clava)* (Woods et al., 2019).

Since the more intensive baseline surveys were completed in 2002 and 2005, four secondary target species have been documented through NMHRSS surveys within Te Awanui (the Asian date mussel *Arcuatula senhousia*, the asicidans *Didemnum vexillum* and *Styela clava*, and the Mediterranean fanworm *Sabella spallanzanii*). A single specimen of a recently introduced invasive solitary, subtidal ascidian tunicate (*Styela clava)* was observed on one wharf pile in the Stella Passage marine assessment (Leonard et al., 2020) based on a small area of wharf pile scrapings taken from the east and west of Stella Passage.

In recent years (2013-present), as part of the bi-annual Tauranga Moana harbour surveillance, a large number of juvenile Mediterranean fanworm *(Sabella spallanzanii)* were discovered on the bottom of a boat moored in the harbour, highlighting the need to keep hulls cleaned. The boat was lifted out, scraped down, treated and returned to the water. Between 2014-2016, Mediterranean fan worms were found on the swing moorings in Pilot Bay, and immediately north and south of the Tauranga Harbour Bridge and in both marinas. In addition, *Sabella* sp.

[25] The Travels of Tuna: New Zealand’s largest migrating fish | Tūhura Otago Museum

was identified during a subtidal survey for the POTL in late 2023, and more than 700 individuals were subsequently eradicated by the BOPRC marine team.

4.11 Water quality

Water quality is overall assessed as in moderate condition within Te Awanui. Tauranga Moana State of the Environment Report (2019) indicates Te Awanui water quality to be of average condition and low nutrient and heavy metal concentrations.

However, ongoing risks threatening Te Awanui water quality are land use intensification increasing the risk of nutrient enrichment and sediment discharges and increased urban development increases the risk of heavy metal contamination (BOPRC. 2019).

Water quality effects will arise from the dredging of the shipping channel through temporary suspension of sediment.

Metals/metalloids were measured in water samples from Tauranga Harbour collected by BOPRC during a 3-week period in 2019. Average metal/metalloid estuarine water concentrations were low and below Australian & New Zealand guidelines for Fresh & Marine Water [and sediment] Quality ANZG (2018) 99 % marine water quality Default Guideline Values (DGV) (Crawshaw, 2021).

4.12 Sediment Grain Size

Leonard et al. (2020) notes the dominant benthic sediment grain size in Te Awanui is sand. de Lange (2022) notes fine sediment accumulates in harbour margins in areas of high sediment supply and low wave activity, otherwise surface sediments generally contain <5 % silt and clay.

4.13 Sediment Quality

All metals surveyed for the Stella Passage consent application were found in concentrations below recommended DGVs as indicated by the ANZG (2018) (Leonard et al., 2020).

Sediment from the proposed dredge sites generally have low contaminant concentrations, similar to the receiving environment sites. In addition, shellfish flesh toxicant concentrations are well within safe consumption limits. Therefore, the risk of toxicants being entrained in the dredged sediment and leaching into the water column in concentrations above water quality guidelines is very low.

de Lange (2024) notes that the areas to be dredged in Stella Passage have low concentrations of contaminants and any contaminants are confined to the surface sediment layer (0.2-0.5 m).

Sediment samples were collected in 2019 (Leonard et al., 2020) for metal concentration analyses. Sample sites were located adjacent to the existing Mount Manganui wharves (B Wharf) (B11-1 to B11-6), Butters Landing (BU-1-BU-6) and adjacent to the Tauranga Marina (CH- 1-CH-6) (Figure 4).

There was limited evidence of metal accumulation in the three sampling sites (Table 2). The concentrations detected by Leonard et al. (2020) are within the range of past recordings (e.g. Ellis et al. (2013), consistent with Clark et al. (2018). Overall, the concentrations of metals was low and below DGV (Leonard et al., 2020), although copper was slightly elevated at one site at Butters Landing (BU-1) (82 mg/kg) and one site near Mount Maunganui Wharves (B11-2[26]) (72 mg/kg). The source of copper at both these sites is likely due to copper in antifouling treatment applied to vessel hulls.

Ellis et al. (2013) and Clark et al. (2018) concurred with Leonard et al. (2020) concluding that Te Awanui contains slight to moderate nutrient enrichment and low levels of heavy metal contamination in sediment. Clark et al. (2018) noted metal and nutrient concentrations were higher in the upper reaches of the channels, where the mud content of sediment and organic matter is higher. Clark et al. (2018) surveyed one site within Stella Passage, located south of the Tauranga bridge marina, found elevated copper concentration, and concluded the source of copper likely due to the antifouling treatment of vessel hulls in the marina.

The low concentration of these metals in the harbour is likely due to both natural sources (weathering of minerals) and human-derived inflows (McIntosh, 1994 and Leonard et al., 2020). The sites studied by Leonard et al. (2020) are shown in Table 2.

Sediment has been collected as part of the Te Paritaha pipi monitoring since 2022. The most recent survey was undertaken in November 2024 (Boffa Miskell Ltd, 2024c). The contaminant results (Boffa Miskell Ltd, 2024d in prep.) revealed low concentrations of metals and polycyclic aromatic hydrocarbons, below DGV values (Table 14 to Table 16).

POTL has also collected sediment from various parts of the southern Te Awanui (Figure 4). Toxicants measured in sediments from the channel and Port area to inform this assessment were generally low but increase with proximity to parts of the Port (e.g. Butters Landing). This conclusion is in line with the data from Leonard et al. (2020).

[26] B11-2 is not shown on the map from Leonard et al. (2020) but is located immediately SE of B11-3.

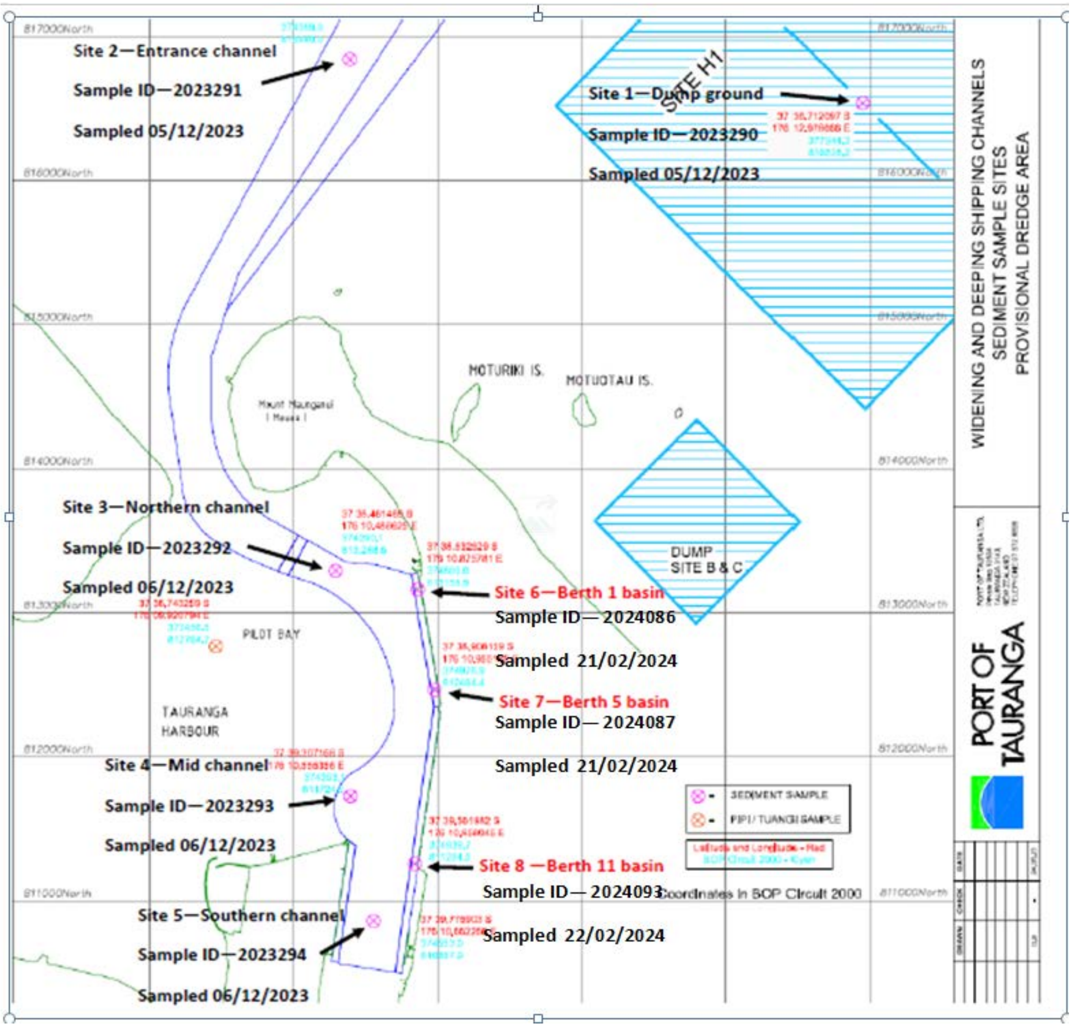

Figure 4: Sediment sampling sites undertaken by the POTL (2023/2024)

Subtidal sediments in Tauranga Harbour, surveyed in 2016 by BOPRC, revealed sandy sediment (67-97 %) with low concentrations of nutrients (lower than intertidal sediments) and low metals concentration. The upper reaches of channels had a higher proportion of mud, organic matter and nutrient concentrations compared to sites close to the main channels (Clark et al., 2018). Metals were highest in sediment from the urbanised southern harbour. Maximum metal concentrations in sediment were below guidelines values.

Nutrients in sediments in Tauranga Harbour are generally low, with Clark et al. (2018) stating that 85 % of sites were graded as good. Heavy metals are measured at 65 intertidal sites in Tauranga Harbour annually. Levels of heavy metal contaminants are generally low, with almost two thirds of sites being graded as very good. Just over one third of sites were graded as good, and no sites were graded as fair or poor. All sites were well below the Australia and New Zealand guidelines (ANZECC, 2000) interim sediment quality guidelines (now named ANZG default guideline values (DGV) for the protection of aquatic life (Clark et al., 2018).

Sedimentation is the process of sediment settlement and accumulation over time in our estuaries. The rate of sedimentation in Tauranga Harbour has increased over the years due to population growth, changing land use and soil disturbance activities related to development.

Sedimentation deposition and sedimentation rates are surveyed at 65 sites across Tauranga Harbour. Sediment is accumulating at higher levels than background rates at 59 % of the sites BOPRC monitor. At 41 % of sites, sedimentation rate is graded as very good, 14 % as good, 36 % as fair and 10 % as poor. Less than half of the monitoring sites for mud deposition were graded as very good or good (46 %). With respect to sites surveyed by Clark et al. (2018), two were to the south of the bridge marina in the Waipu Estuary, one south of Panepane Point, and one NE of Sulphur Point. These sites were graded for Mud BHM 1, 4, 2 and 2 respectively. A third of all sites surveyed by Clark et al. (2018) had a mud content that was graded as poor (33 %) for Mud Benthic Health Model (Mud BHM) (Clark et al., 2018), none of these sites are within the Stella Passage or Southern Harbour.

Table 2: Metal concentrations (mg/kg dw) in metals collected in Stella Passage sediment (Leonard et al., 2020) compared to ANZG DGVs.

		Site Name					
	ANZG DGV	B11-1	B11-2	B11-3	B11-4	B11-5	B11-6
Arsenic	20	4	3	4	5	4	4
Cadmium	1.5	0.05	0.05	0.05	0.05	0.05	0.05
Chromium	80	4	3	6	6	5	4
Copper	65	6	72	5	4	1	1
Lead	50	4.3	4	5	5.3	2.7	3.6
Nickel	21	1	1	1	2	1	1
Zinc	200	25	25	34	34	14	21
		Site Name					
	ANZG DGV	BU-1	BU-2	BU-3	BU-4	BU-5	BU-6
Arsenic	20	6	10	5	5	5	5
Cadmium	1.5	0.12	0.13	0.05	0.05	0.05	0.05
Chromium	80	9	15	9	6	5	6
Copper	65	82	24	6	5	4	5
Lead	50	7.4	10.3	5	4.9	4.6	5.9
Nickel	21	4	5	4	1	2	3
Zinc	200	67	79	30	27	27	33
		Site Name					
	ANZG DGV	Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6
Arsenic	20	7	7	9	7	7	8
Cadmium	1.5	0.05	0.05	0.05	0.05	0.05	0.05
Chromium	80	4	4	3	3	4	4
Copper	65	1	1	1	1	1	1
Lead	50	3.6	3.1	3.1	3	3.6	3.4
Nickel	21	1	1	1	1	1	1
Zinc	200	34	31	28	21	26	25

4.14 Ecological Significance of Marine Habitats with reference to BOPRC RPS criteria

There are many significant marine habitats of indigenous flora and fauna according to the Bay of Plenty Regional Policy Statement (RPS) criteria[27], but are not identified/listed as Indigenous Biodiversity Areas.

[27] https://atlas.boprc.govt.nz/api/v1/edms/document/A4439678/content

Grace (para 167, 2010) assessed the many habitats and areas in Te Awanui as “significant habitats of indigenous fauna” according to the criteria in Appendix F, Set 3 of the RPS (see Appendix 5) (criteria are included in brackets for each feature within Stella Passage). I have assessed the habitats against the RPS criteria and concur with Grace’s significance assessment of the relevant criteria for Stella Passage, Wharf Structures, Centre Bank, and Seagrass beds, acknowledging that the last two locations are outside of the project works footprint.

1. Stella Passage (3.1, 3.12);
2. Wharf Structures (3.10);
3. Centre Bank (Te Paritaha) (3.5, 3.8, 3.10, 3.11, 3.14, 3.15, 3.16, 3.17); and
4. Seagrass Beds (3.1, 3.6).

4.14.1 Stella Passage

Stella Passage contains indigenous habitat of indigenous fauna that contain associations of indigenous species that are representative, typical and characteristic of the natural diversity of harbour habitats in the Bay of Plenty region.

The subtidal soft sediment habitats in Stella Passage contain a range of both sensitive and tolerant benthic invertebrates that support other fauna, such as fish. The existing wharf structures (hard shore) are inhabited by a characteristic diversity of sessile marine invertebrates.

The Stella Passage comprises habitats of indigenous fauna support intact habitats and healthy functioning ecosystems i.e. the subtidal soft sediment habitat (albeit in part previously dredged and naturally recovered) and the wharf pile habitat contain intact, diverse communities of benthic invertebrates forming a healthy ecosystem.

4.14.2 Wharf structures

Existing Maunganui Roads wharf structures (**Error! Reference source not found.**) provide habitat for indigenous juvenile crayfish – a key stage of their life cycle.

4.14.3 Centre Bank (Te Paritaha)

Te Paritaha (**Error! Reference source not found.**) is consistent with numerous RPS criteria (above). In summary, Te Paritaha is the largest pipi bed in Te Awanui and potentially the BOP region, it is in a healthy state, it provides habitat for juvenile pipi, has the size and shape to maintain ecological viability over time, is culturally significant, and has community values.

4.14.4 Seagrass beds

Seagrass beds are considered significant as they provide shelter, food, and nursery grounds for a variety of marine organisms (including juvenile fish, crustaceans etc.). Seagrass meadows are an important component of Te Awanui habitats, being present at Tuapiro, Ōtūmoetai, Waimapu, Ōmokoroa, Pahoia, Waiau, Matahui, Waipu Bay, Pilot Bay, Te Puna and Ongare. The nearest seagrass meadow to the POTL is the bed adjacent to the Whareroa marae in Waipu Bay.

4.14.5 Summary

The habitats within Stella Passage are characterised by Battershill (2022) as being typical of a working Port in a harbour/estuarine environment, whilst also satisfying the RPS criteria for significance as detailed above.

Seagrass, orca and bottlenose dolphins aside, the marine habitats and species are not relevant to considerations of the NZCPS 11 (a) as there are no At Risk or Threatened marine species or ecosystems present.

4.15 Previous ecological values/magnitude of effects assessments by other marine scientists

The Joint Witness Statement (JWS) for Marine Ecology (2022) does not state any matters of disagreement. The JWS notes that the harbour is a dynamic changing system, with fluctuations in pipi populations, cockle beds, horse mussels, and other taxa. The JWS states that there are incremental changes in pipi populations, seagrass and cockle beds and other species, which are related to long-term alterations in the wider Te Awanui (including land runoff of sediment) and fishing plus activities such as dredging which form part of the cumulative effects – all of which I agree with. The assessment of marine ecological values, nor magnitude of effect, was not traversed in the JWS.

5.0 Marine Ecology Assessment Methodology

The approach used to undertake this assessment is in line with the EIANZ guidelines for undertaking ecological impact assessments Roper-Lindsay et al., Ecological Impact Assessment (EcIA). EIANZ Guidelines for Use in New Zealand: Terrestrial and Freshwater Ecosystems (and now marine ecosystems), whereby ecological values (Table 3) are assigned, and the magnitude of effects identified (Table 5) in order to help determine the overall level of effect of the proposal (Table 6).

Very recently (November 2024), guidelines/criteria for the assessment of marine ecological values have been developed and are now published on the EIANZ website. The development of the marine guidelines has involved Dr De Luca as lead collaborator and have drawn on the approach used in Dr De Luca's previous expert witness evidence for Board of Inquiry and Environment Court consenting processes for major infrastructure projects[28].

In order to fully understand the effects of the proposal, this assessment has been undertaken at two spatial scales, being the Stella Passage scale and the southern Te Awanui (Tauranga Harbour) scale. This involves not only looking at the effects of the proposal in relation to two different spatial scales, but also considering the different ecological context and values of Stella

[28] See evidence of Dr De Luca in Board of Inquiry Hearings for NZTA Projects: Pūhoi to Warkworth, Waterview Connection, Transmission Gully, Mackays to Peka Peka, East West Link and Te Ara Tupua.

Passage versus the entire southern Te Awanui and describing how these ecological values will/will not be impacted.

The marine ecological values (hard and soft shore) described in this report are based on criteria that range from negligible to very high (Table 3 and Table 4).

According to Roper-Lindsay et al. (2018), the overall level of effect can then be used to guide the extent and nature of the ecological management response required:

- Very high adverse effects require a net biodiversity gain[29] (the comparative RMA language is significant adverse effects)
- High and moderate adverse effects require no net loss of biodiversity values (the comparative RMA language is between "significant" adverse effects and "minor" adverse effects)
- Low and very low effects are not typically of ecological concern. If effects are assessed taking impact management developed during Project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low effects (the comparative RMA language is between "less than minor" adverse effects and "de minimus" adverse effects).

The scale for classifying the magnitude of effect is presented in Table 5. The guiding matrix for classifying the overall level of effect, combining ecological value and magnitude of effects, is presented in Table 6.

Table 3: Qualitative and quantitative fine scale attributes for assigning ecological values for ***rocky/hardshore benthic habitats***

ECOLOGICAL VALUE	ATTRIBUTE
VERY HIGH	Rocky/artificial substrate abundant, providing very high topographic complexity
	Very low sediment cover on rocky substrate
	Very high diversity and abundance of sessile benthic organisms for the habitat type
	Very high diversity and abundance of mobile macroinvertebrates for the habitat type
	Sessile and mobile benthic organisms comprise many sensitive taxa. Invasive, opportunistic and/or disturbance tolerant species largely absent or low abundance.
	Biogenic habitat formations (e.g., perennial algal canopies, shellfish aggregations) have very large spatial extent and very low patchiness
	Very high diversity and abundance of fish[30] for the habitat type
	Threatened or At Risk marine species[2] present and may be abundant
	Large areas of threatened ecosystem type present
	Habitat unmodified

[29] Though when ecological compensation is required because biodiversity offsetting is not possible, the principles of no-net-loss or net-gain do not apply (Maseyk et al., 2018).

[30] Species of fish and other large fauna can be separated into individual values assessment, depending on the scale of the activity and the species present.

ECOLOGICAL VALUE	ATTRIBUTE
	Water quality contaminant concentrations typically at or better than ANZG 99% species protection level and/or scored as 'Excellent' on a recognised Water Quality Index (WQI).
HIGH	Rocky/artificial substrate abundant, providing high topographic complexity
	Low sediment cover on rocky substrate
	High diversity and abundance of sessile benthic organisms for the habitat type
	High diversity and abundance of mobile macroinvertebrates for the habitat type
	Sessile and mobile benthic organisms comprise many sensitive taxa. Invasive, opportunistic and/or disturbance tolerant species largely absent
	Biogenic habitat formations (e.g., perennial algal canopies, shellfish aggregations) have large spatial extent and low patchiness
	High diversity and abundance of fish for the habitat type
	Threatened or At Risk marine species[2] present
	Threatened ecosystem type present
	Limited habitat modification
	Water column contaminant concentrations typically between ANZWQG 95% and 99% species protection levels and/or scored as 'Good' on a recognised WQI
MODERATE	Rocky/artificial substrate provides moderate topographic complexity
	Moderate sediment cover on rocky substrate
	Moderate diversity and abundance of sessile benthic organisms for the habitat type
	Moderate diversity and abundance of mobile macroinvertebrates for the habitat type
	Sessile and mobile benthic organisms comprise both tolerant and sensitive taxa
	Biogenic habitat formations (e.g., perennial algal canopies, shellfish aggregations) have moderate spatial extent and moderate patchiness
	Moderate diversity and abundance of fish for the habitat type
	Few Threatened or At Risk marine species[2] present
	Few Threatened ecosystems present
	Moderate habitat modification
	Water column contaminant concentrations typically between ANZWQG 90% and 95% species protection levels and/or scored as 'Fair' on a recognised WQI
LOW	Rocky/artificial substrate provides limited topographic complexity
	High sediment cover on rocky substrate
	Low diversity and abundance of sessile benthic organisms for the habitat type, but high cover of opportunistic macroalgae possible
	Low diversity and abundance of mobile macroinvertebrates for the habitat type
	Sessile and mobile benthic organisms comprise mostly invasive, opportunistic and disturbance-tolerant taxa, with very few sensitive taxa present
	Biogenic habitat formations (e.g., perennial algal canopies, shellfish aggregations) absent, but biogenic habitat formers may be present in low abundance
	Low diversity and abundance of fish for the habitat type
	No Threatened or At Risk marine[2] species present
	No Threatened ecosystem type present

ECOLOGICAL VALUE	ATTRIBUTE
	High habitat modification
	Water column contaminant concentrations typically between ANZWQG 80% and 90% species protection levels and/or scored as 'Marginal' on a recognised WQI
NEGLIGIBLE	Rocky/artificial substrate sparse, providing limited topographic complexity
	Rocky substrate smothered by sediment
	Very low diversity and abundance of sessile benthic organisms for the habitat type
	Very low diversity and abundance of mobile macroinvertebrates for the habitat type
	Sessile and mobile benthic organisms comprise only invasive, opportunistic and disturbance-tolerant taxa, with no sensitive taxa present
	Biogenic habitat formations (e.g., perennial algal canopies, shellfish aggregations) absent
	Very low diversity and abundance of fish for the habitat type[31]
	No Threatened or At Risk marine species[32] present
	No Threatened ecosystem[33] type present
	Very High habitat modification
	Water column contaminant concentrations typically at or worse than ANZWQG 80% species protection levels and/or scored as 'Poor' on a recognised WQI

[31] Species of fish and other large fauna can be separated into individual values assessment, depending on the scale of the activity and the species present.

[32] Marine mammals and coastal birds have been excluded as a characteristic of marine habitats as separate specialist experts in marine mammals and coastal birds should be engaged. Marine mammals and coastal birds can form part of the characteristics around presence of 'Threatened' or 'At Risk' species when supported by a relevant experts.

[33] As per (Holdaway et al., 2012) for this parameter in all levels of ecological value.

Table 4: Qualitative and quantitative fine scale attributes for assigning ecological values for soft sediment benthic habitats[34]

ECOLOGICAL VALUE	ATTRIBUTE
VERY HIGH	Benthic invertebrate community typically has very high diversity, species richness and abundance for the habitat type
	Benthic invertebrate community is dominated by taxa that are sensitive to organic enrichment, contaminants and mud e.g. rated as 'Excellent' using the Auckland Council (AC) or National Benthic Health Model (BHM)[35] or similar index
	Invasive opportunistic and disturbance tolerant species absent[36]
	Marine sediments typically comprise < 20% silt and clay grain sizes[37] (mud) or rated as 'Excellent' using the AC BHMmud or similar index
	Surface sediment oxygenated to >5 cm depth[38] with no anoxic sediment present
	Annual average sedimentation rates typically less than 1 mm above background levels [39]
	Contaminant concentrations in surface sediment significantly below DGV and AC ERC-Orange effects threshold concentrations[40].
	Contaminant concentrations in shellfish at or below natural background levels or not above conservative laboratory detection limits
	Water column contaminant concentrations typically at or better than ANZWQG 99% species protection level and/or scored as 'Excellent' on a recognised Water Quality Index (WQI)[41]
	Fish community typically has very high diversity, species richness and abundance[42]
	Native estuarine vegetation or macroalgae community intact and provides significant habitat for native fauna
HIGH	Benthic invertebrate community typically has high diversity, species richness and abundance for the habitat type
	Benthic invertebrate community contains many taxa that are sensitive to organic enrichment, contaminants and mud. E.g. rated as 'Good' using the AC or National BHM or similar index
	Invasive opportunistic and/or disturbance tolerant species largely absent
	Marine sediments typically comprise <40% silt and clay grain sizes or rated as 'Good' using the AC BHMmud or a similar index
	Surface sediment oxygenated up to 5cm depth
	Annual average sedimentation rates typically less than 2 mm above background levels

[34] Methodologies and considerations for measuring a number of these attributes can be found within the "National Estuary Monitoring Protocol" and "Managing Upstream" project reports. Go to https://environment.govt.nz/publications/ to search for the latest versions.

[35] Hewitt, J E., Lohrer, A M and Townsend, M (2012). Health of estuarine soft-sediment habitats: continued testing and refinement of state of the environment indicators. Prepared by NIWA for Auckland Council. Auckland Council technical report, TR2012/012

[36] https://www.marinebiosecurity.org.nz/

[37] Silt and clay percentage of sediment adjusted to be consistent with BHMud Model

[38] Robertson, B.M, Stevens, L., Robertson, B., Zeldis, J., Green, M., Madarasz-Smith, A., Plew, D., Storey, R., Oliver, M. 2016. NZ Estuary Trophic Index Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index, MBIE/NIWA Contract No: C01X1420. 68p.

[39] Townsend and Lohrer (2015). ANZECC Guidance for Estuary Sedimentation. Prepared for Ministry for the Environment by NIWA

[40] ANZG (2018) Default Guideline Value concentrations, or Auckland Council's Environmental Response Criteria contaminant threshold concentrations (Auckland Regional Council TP168, 2004)

[41] E.g., Ingley, R (2021). Coastal and estuarine water quality state and trends in Tāmaki Makaurau / Auckland 2010-2019. State of the environment reporting. Auckland Council technical report, TR2021/02.

[42] https://www.mpi.govt.nz/legal/legislation-standards-and-reviews/fisheries-legislation/maps-of-nz-fisheries/

ECOLOGICAL VALUE	ATTRIBUTE
	Contaminant concentrations in surface sediment rarely exceed DGV concentrations and AC ERC-Orange effects threshold concentrations.
	Where shellfish are present, flesh has contaminant concentrations close to natural background levels or not above conservative laboratory detection limits
	Water column contaminant concentrations typically between ANZWQG 95% and 99% species protection levels and/or scored as 'Good' on a recognised WQI
	Fish community typically has high diversity, species richness and abundance
	Native estuarine vegetation or macroalgae community dominated by native species and provides high quality habitat for native fauna
	Nuisance phytoplankton or macroalgal blooms may occur infrequently at a limited spatial scale
	Threatened or At Risk marine species present
	Threatened ecosystem types present
	Physical habitat largely unmodified
MODERATE	Benthic invertebrate community typically has moderate species richness, diversity and abundance for the habitat type
	Benthic invertebrate community has taxa both tolerant and sensitive to organic enrichment, contaminants and mud present E.g. rated as 'Fair' using the AC or National BHM or similar index
	Few invasive opportunistic and/or disturbance tolerant species present
	Marine sediments typically comprise less than <60% silt and clay grain sizes or rated as 'Fair' using the AC BHMmud or similar index
	Shallow depth of oxygenated surface sediment to 1-2 cm depth
	Annual average sedimentation rates typically less than 5 mm above background levels
	Contaminant concentrations in surface sediment generally below DGV and AC ERC-Red effects threshold concentrations[43]
	Where shellfish are present, flesh has low to moderate contaminant concentrations present compared to natural background levels
	Water column contaminant concentrations typically between ANZWQG 90% and 95% species protection levels and/or scored as 'Fair' on a recognised WQI
	Fish community typically has moderate species richness, diversity and abundance
	Native estuarine vegetation and macroalgae community dominated by native species and provides moderate habitat for native fauna
	Nuisance phytoplankton or macroalgal blooms may occur sporadically over a moderate spatial scale
	Few Threatened or At Risk marine species present
	Few Threatened ecosystems present
	Physical habitat moderately modified
LOW	Benthic invertebrate community degraded with low species richness, diversity and abundance for the habitat type
	Benthic invertebrate community dominated by organic enrichment tolerant, contaminant tolerant and mud tolerant organisms with few/no sensitive taxa present e.g. rated as 'Marginal' using the AC or National BHM or similar index
	Invasive, opportunistic and/or disturbance-tolerant species dominant

[43] Auckland Council's Environmental Response Criteria contaminant threshold concentrations (Auckland Regional Council TP168, 2004).

ECOLOGICAL VALUE	ATTRIBUTE
	Marine sediments dominated by silt and clay grain sizes (>60%) or rated as 'Marginal' using the AC BHMmud or similar index
	Surface sediment predominantly anoxic (lacking oxygen)
	Annual average sedimentation rates typically less than 10 mm above background levels
	Elevated contaminant concentrations in surface sediment, between ANZG Default Guideline Values (DGV) and GV-High effects threshold concentrations
	Where shellfish are present, flesh has moderate contaminant concentrations present compared to natural background levels
	Water column contaminant concentrations typically between ANZWQG 80% and 90% species protection levels and/or scored as 'Marginal' on a recognised WQI
	Fish community depleted with low species richness, diversity and abundance
	Native estuarine vegetation and/or macroalgae community provides minimal/limited habitat for native fauna.
	Nuisance phytoplankton or macroalgal blooms may occur commonly over a moderate scale
	No Threatened or At Risk marine species present
	No Threatened ecosystem present
NEGLIGIBLE	Physical habitat highly modified
	Benthic invertebrate community dominated by organic enrichment tolerant, contaminant tolerant, and mud tolerant organisms with no sensitive taxa present. E.g. rated as 'Poor' using the Auckland Council or National[44] Benthic Health Models or similar indices
	Invasive, opportunistic and disturbance tolerant species highly dominant
	Marine sediments dominated by silt and clay grain sizes (>80%) or rated as 'Poor' using a BHMmud or similar index
	Surface sediment anoxic (lacking oxygen)
	Annual average sedimentation rates typically greater than 10 mm above background levels
	Elevated contaminant concentrations in surface sediment, above ANZG Guideline Values – High (GV-High) effects threshold concentrations[45]
	Where shellfish are present, flesh has moderate-high contaminant concentrations Present compared to natural background levels
	Water column contaminant concentrations typically at or worse than ANZWQG 80% species protection levels and/or scored as 'Poor' on a recognised WQI
	Fish community depleted with very low species richness, diversity and abundance[46]
	Native estuarine vegetation or macroalgae absent or so sparse as to provide very limited ecological value
	Nuisance phytoplankton or macroalgal blooms may occur frequently over a large spatial scale
	No Threatened or At Risk marine species present[47]
	No Threatened ecosystems present

[44] D.E. Clark, J.E. Hewitt, C.A. Pilditch, J.I. Ellis (2020). The development of a national approach to monitoring estuarine health based on multivariate analysis. Marine Pollution Bulletin, Volume 150.

[45] ANZG (2018) Australian and New Zealand Guidelines for Freshwater and Marine Water Quality (replaced previous ANZECC guidelines)

[46] Species of fish and other large fauna can be separated into individual values assessment, depending on the scale of the activity and the species present

[47] Marine mammals and coastal birds have been excluded as a characteristic of marine habitats as separate specialist experts in marine mammals and coastal birds should be engaged. Marine mammals and coastal birds can form part of the characteristics around presence of 'Threatened' or 'At Risk' species when supported by relevant experts

ECOLOGICAL VALUE	ATTRIBUTE
	Physical habitat extremely modified

Table 5: Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018).

MAGNITUDE	DESCRIPTION
VERY HIGH	Total loss of, or very major alteration, to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element / feature.
HIGH	Major loss or major alteration to key elements/ features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element / feature.
MODERATE	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element / feature.
LOW	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature.
NEGLIGIBLE	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the "no change" situation; AND/OR Having a negligible effect on the known population or range of the element / feature.

Table 6: Based on the criteria for describing the level of effect (Roper-Lindsay et al., 2018)

LEVEL OF EFFECT		ECOLOGICAL AND / OR CONSERVATION VALUE				
		Very High	High	Moderate	Low	Negligible
MAGNITUDE	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

6.0 Assessment of Marine Ecological Values

The ecological values of the marine environment within Stella Passage and the Southern Te Awanui areas are overall assessed as High (Table 3), based on the following criteria relevant to the Project.

Table 7: Assessment of Existing Hard Shore Marine Ecology against the relevant criteria (Table 3)

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
LOW (Stella Passage) AND MODERATE (Southern harbour)	Physical habitat highly modified[48] (Stella Passage). Physical habitat moderately modified (Southern Harbour)	The Stella Passage physical habitat has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation and wharves to the south, Mount Maunganui reclamations and wharves to the north and the dredged shipping channel within the Stella Passage. The wider southern harbour can be considered modified due to the existing and historic dredging, wharf construction, sedimentation and there being only around 60 % of natural coastal edge remaining (**Error! Reference source not found.**).
MODERATE (Stella Passage) AND HIGH	Hard shore habitat comprises wharf piles primarily plus reclamation revetments[49] (Stella Passage). and Rocky shores of Mauāo (Southern Harbour)	The Stella Passage physical habitat has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation to the south, Mount Maunganui reclamations to the north and the dredged shipping channel within the Stella Passage.

[48] Stella Passage has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation to the west and the dredged shipping channel to the north

[49] Stella Passage has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation to the west and the dredged shipping channel to the north.

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
(Southern harbour)		The wider southern harbour can be considered modified due to the existing and historic dredging, sedimentation and there being only around 60 % of natural coastal edge remaining (**Error! Reference source not found.**). Wharf piles are artificial but provide habitat for a range of sessile and encrusting species. Mauāo rocky shores contain a range of rocky shore sessile and encrusting species as well as mobile benthic organisms.
MODERATE (Stella Passage and Southern Harbour)	Few invasive opportunistic and/or disturbance tolerant species present[50].	The asicidans *Didemnum vexillum* and *Styela clava,* and the Mediterranean fanworm *Sabella spallanzanii* are present on hard structures in the wider harbour.
	Water column contaminant concentrations typically between ANZWQG 90% and 95% species protection levels and/or scored as 'Fair' on a recognised WQI[51].	Water quality data revealed metal/metalloid estuarine water concentrations were low and below ANZG 99% marine DGV (Crawshaw, 2021).
	High diversity and abundance of fish for the habitat type.	The wharf structures at Mt Maunganui and Sulphur Point have high marine biodiversity (including a range of anemones, barnacles, sponges, sea squirts and hydroids). All pile communities are representative of a complex, healthy estuarine/harbour habitat.
HIGH (Stella Passage and Southern Harbour)	High diversity and abundance of fish for the habitat type	There is a consistent and diverse fish population in Te Awanui, with the port area supporting significant juvenile and adult fish populations, including eagle ray, snapper, trevally, kingfish, gurnard, kahawai, parore, and spotty.
	Native estuarine vegetation or macroalgae community dominated by native species and provides high quality habitat for native fauna[52].	Seaweeds The hard structures in the harbour, such as existing rocks and concrete sides, support attached species of macroalgae such as *Ecklonia radiata*, *Ulva lactuca*, *Ulva* spp, *Codium fragile*, *Hormosira banksii*, *Undaria pinnatifida*[53], *Gracilaria chilensis*, and *Gigartina* species.

[51] See Water Quality section 3.14

[52] See Marine Vegetation section 3.11

[53] Exotic

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
		Macroalgae are not a dominant habitat feature in the Stella Passage area (but macroalgae is present within adjacent rocky reef habitats). Stella Passage marine environment primarily consists of soft sediment benthic habitat and hard structures such as wharf piles. The rapid water flow does not encourage macroalgae to proliferate in the soft sediment Stella Passage compared to reefs in the outer harbour.

Table 8: Assessment of Existing Soft Sediment Marine Ecology against the relevant criteria (Table 4)

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
LOW (Stella Passage) AND MODERATE (Southern harbour)	Physical habitat highly modified[54] (Stella Passage). Physical habitat moderately modified (Southern Harbour)	The Stella Passage physical habitat has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation to the south, Mount Maunganui reclamations to the north and the dredged shipping channel within the Stella Passage. The wider southern harbour can be considered modified due to the existing and historic dredging, sedimentation and there being only around 60 % of natural coastal edge remaining (**Error! Reference source not found.**).
MODERATE (Stella Passage and Southern Harbour)	Few invasive opportunistic and/or disturbance tolerant species present.	The Asian date mussel *Arcuatula senhousia*, the asicidans *Didemnum vexillum* and *Styela clava,* and the Mediterranean fanworm *Sabella spallanzanii* are present in the wider harbour.
	Water column contaminant concentrations typically between ANZWQG 90% and 95% species protection levels and/or scored as 'Fair' on a recognised WQI[55].	Water quality data revealed metal/metalloid estuarine water concentrations were low and below ANZG 99% marine DGV (Crawshaw, 2021).

[54] Stella Passage has been highly modified by various activities and infrastructure, with the harbour bridge to the south, causeway to the east, marina to the southeast, Sulphur Point reclamation to the west and the dredged shipping channel to the north

[55] See Water Quality section 3.14

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
		Sediment from the proposed development soft sediment sites generally have low contaminant concentrations, similar to the wider receiving environment sites. Therefore, the risk of toxicants being entrained in the dredged sediment and leaching into the water column in concentrations above water quality guidelines is very low.
	Few Threatened ecosystems present[56].	Estuaries are classified as vulnerable ecosystem A2(c) short term decline in ecological function. (Holdaway et al., 2012).
HIGH (Stella Passage and Southern Harbour)	Benthic soft sediment[57] and hard shore[58] community typically has high diversity species richness and abundance[59], for the habitat type.	Soft Shore The soft sediment marine communities are in a cyclic pattern of recovery, continually reset with primarily maintenance dredging. The Te Awanui channel floor in the Stella Passage as being reflective of a working port seabed, comprising an ecologically productive benthic community with naturally diverse indigenous native infaunal species. The average Shannon Weiner Diversity Index across the 15 soft sediment benthic tow sites was 2.3, indicating high diversity.
	Benthic invertebrate community contains many taxa that are sensitive to organic enrichment, contaminants and mud[50].	Benthic invertebrates collected from benthic tows in Stella Passage and found an abundant[60] and diverse[61] community with sensitive and tolerant species.
	Fish community typically has high diversity, species richness and abundance.	Leonard (2020) provides fish diversity and abundance at various sites in the Southern Te Awanui and the Port area. There is a consistent and diverse fish population in Te Awanui, with the port area supporting significant juvenile and adult fish populations, including eagle ray, snapper, trevally, kingfish, gurnard, kahawai, parore, spotty, and expected diadromous tuna at certain times of the year.

[56] (Holdaway et al., 2012) – estuaries classified as vulnerable A2(c) short term decline in ecological function.

[57] See Stella Passage Benthic Soft Shore Habitat section 3.2

[58] See Rocky Shores/Reefs of Mauou, Moturiki and Motuotau (section 3.4) and Sessile organisms on wharf structures (section 3.10).

[59] See Stella Passage Benthic Soft Shore Habitat section 3.2 and Sessile organisms on wharf structures section 3.10.

[60] Average number of individuals per benthic tow 97, with an average number of taxa of 17

[61] Average Shannon-Wiener Diversity Index 2.3

Ecological Value	Criteria / Characteristic	Data Summary (with reference to Section 3.0)
	Marine sediments typically comprise <40% silt and clay grain sizes[62]	The dominant benthic sediment grain size in Te Awanui is sand with some fine sediment accumulating in harbour margins in areas of high sediment supply and low wave activity, otherwise sediments generally contain <5% silt and clay.
	Contaminant concentrations in surface sediment rarely exceed DGV concentrations[63]	All metal concentrations in sediment were found to be below recommended Default Guideline Values (DGV) (ANZG, 2018)
	Where shellfish are present, flesh has contaminant concentrations close to natural background levels or not above conservative laboratory detection limits[64].	Shellfish flesh (pipi) toxicant concentrations are low and well within safe consumption limits.
	Native estuarine vegetation or macroalgae community dominated by native species and provides high quality habitat for native fauna[65].	<u>Seaweeds</u> The hard structures in the harbour, such as existing rocks and concrete sides, support attached species of macroalgae such as *Ecklonia radiata*, *Ulva lactuca*, *Ulva* spp, *Codium fragile*, *Hormosira banksii*, *Undaria pinnatifida*[66], *Gracilaria chilensis*, and *Gigartina* species. Macroalgae are not a dominant habitat feature in the Stella Passage area (but is present within adjacent rocky reef habitats) which primarily consists of soft sediment benthic habitat (apart from hard structures such as wharf piles). The rapid water flow does not encourage macroalgae to proliferate in the Stella Passage compared to reefs in the outer harbour.

[62] See Sediment Grain Size section 3.15

[63] See Sediment Quality section 3.16

[64] See Pipi Chemistry Data 2023 and 2024 section 3.9

[65] See Marine Vegetation section 3.11

[66] Exotic

Overall, given the dominance of HIGH and MODERATE ecological value criteria (for both hard and soft shores), along with a few LOW value ecological criteria, on balance, I have conservatively assessed the marine ecological values within the areas potentially affected by the proposed POTL Stella Passage Development and the wider Southern Harbour to have HIGH ecological values[67].

[67] Assessed at the Stella Passage and Southern Te Awanui spatial scales.

7.0 Marine Effects Assessment

7.1 Main marine ecological effects

The primary marine ecological effects from the Stella Passage Development potentially include:

- Effects on coastal processes;
- Permanent loss of benthic CMA due to reclamation and permanent occupation;
- The mortality and disturbance of benthic invertebrates within the areas of reclamation, permanent occupation, dredging and disposal;
- Coastal edge modification;
- The shading of the CMA by wharf structures;
- Increased concentration of suspended sediment (TSS) (including assessment of resuspended contaminated sediment) during dredging, reclamation and installation of permanent structures;
- Underwater noise and vibration during piling activities; and,
- Cumulative effects.

Given the available data on Stella Passage and the southern Te Awanui, there does not seem to be uncertainty in the information or the ecological values present. Therefore, there is not a need for a precautionary approach when considering the effects and management of the proposal.

7.1.1 Coastal processes effects from dredging, reclamation and wharf extensions

de Lange has provided a detailed assessment of coastal processes and hydrodynamic effects of the proposed dredging (de Lange, 2024).

Dredging of the Stella Passage for shipping has previously occurred up to a line across the channel between the southern end of the Tanker Berth and the southern end of the Sulphur Point wharves. The deepened channel has a depth below chart datum of 14.5 m, significantly increasing the cross-sectional area of the channel. This has consequently caused a sharp drop in current speeds and an associated impact on sedimentation in the area. The reduced current speeds are too slow to permit bedload sediment transport through the dredged channel. In addition, the reduced current speeds and the deepened channel combine to act as a sediment trap for the very fine sands and silts, such that slow accumulation of fine sediment occurs (de Lange 2024).

The modelling of the physical changes to the southern harbour at the proposed dredged area shows current speed will be reduced and there may be a change in current direction associated with the abrupt depth transition. Changes to sediment transport is expected to be minimal and highly localised to the area being dredged (de Lange, 2024).

There will be a loss of any pipi within the area to be dredged and within the footprint of the proposed wharf extensions and reclamation. Tuangi (cockles) and pipi found in the areas adjacent to the dredging will be subject to increased turbidity during dredging operations. The turbidity effect on water quality is deemed to be transient ((W. de Lange, 2024)) and evidence suggests that environmental effects will be negligible.

The extensions to the shipping channel and sitting basins are required to enable the vessels to berth at the proposed wharves. The design depth of 16.0 m below CD is the same as that consented (Resource Consents 65806 and 65807) for the existing channel.

Based on review of work carried out by Mullarney & de Lange (2018) the effects of dredging on main navigational channel stability and stability of Te Paritaha are considered to be negligible.

Based on the assessment of sediment plume by (W. de Lange, 2024) it is concluded that any elevated TSS or turbidity will occur within the mixing zone and that there will be no more than minor effects outside of the mixing zone (200m upstream of the dredge to 600m south of the dredge).

(W. de Lange, 2024) states that overall, the effects of Stages 1 and 2 development in Stella Passage on sedimentation and hydrodynamic processes within Te Awanui are very similar, with the combined effects of both stages having less than minor effects, subject to the adoption of the appropriate mitigation measures:

a. For the excavation phase, the effects on sedimentation and turbidity are dependent on the characteristics of the TSHD used and the specific geological units encountered. Based on previous capital dredging programmes and numerical modelling, any effects due to these factors will be less than minor.

b. For the reclamations, there will be slight differences depending on the scale of the reclamation and the sources of the sediment used for each reclamation. Since the reclamation sediment plumes are smaller scale than the TSHD plumes, the differences are expected to be less than minor.

c. For the post-dredging recovery phase, beyond the immediate environs of Stella Passage, the impacts are negligible to undetectable. Within Stella Passage, Stage 1 will predominantly affect flows along the western side of the southern end of the channel, while Stage 2 will affect flows across the whole width of the southern end. In the central section of the channel, Stage 1 is likely to have the largest impact on flows through the modification of the ebb tide eddy. This will be modified further by the Mount Maunganui Wharf extension. Modelling demonstrates no impact on flows at the northern end of Stella Passage, except for a slight reduction in peak velocities when the channel is deepened to 16 m. Overall, the predicted hydrodynamic changes are not significant.

Some areas within Te Awanui have previously been identified as specific areas of concern, and these were assessed individually (de Lange, 2024):

1. Te Paritaha – the proposed dredging in Stella Passage will have no detectable effect on tidal currents over the ebb shield. Sedimentation and turbidity from dredging plumes will also not be detectable at Te Paritaha.

2. Panepane (southern-most part of Matakana Island) – the proposed dredging in southern Stella Passage will have no effect on tidal currents or wave action in the vicinity of Panepane and will not contribute to the dynamic changes of the point.

3. Tauranga Bridge Marina entrance – none of the numerical models show a detectable change in tidal velocities near the entrance to the Bridge Marina.
4. Whareroa marae – the proposed dredging in southern Stella Passage will have no detectable effect on tidal currents, sedimentation or turbidity for the Whareroa marae foreshore.
5. Katikati Basin – the proposed dredging in southern Stella Passage will have no effect on the Katikati Basin and locations within it, as it is too far away and is effectively a separate water body in terms of tidal propagation.
6. Opopoti Marae, Maungatapu Peninsula, Motuhoa Island, and Matakana Point - the proposed dredging in southern Stella Passage will have no effect on tidal currents, sedimentation, shoreline erosion, and mean or extreme sea levels at these locations.

The assessment spatial scales are the Stella Passage and the southern Te Awanui (Figure 2). The magnitude of effect (Table 5) is considered negligible because changes to sediment transport will be minimal and highly localised and because the channel stability will not be compromised at either spatial scale. With high ecological values, the overall level of effect of coastal processes changes to marine ecological values is **Very Low** (Table 6).

7.1.2 Permanent loss of benthic CMA due to reclamation and permanent occupation.

Permanent loss of benthic marine habitat will occur due to the proposed reclamations, revetments, seawalls, and installation of piles to construct wharf extensions. These activities also extend the occupation of already modified coastal edge further seaward but do not involve any further modification of natural harbour edges.

To tie the existing Port land to the back of the wharves, 3.58 Ha reclamation of the coastal marine area will be required. Reclamation of 1.77 Ha is proposed to support the extension of the Mount Maunganui Wharves. Reclamation of 0.88 (Stage 1) and 0.93 Ha (Stage 2) south of the existing wharf at Sulphur Point is proposed to support the extension of that wharf.

Timing of the works and suitability of the material will dictate whether the material used in the reclamation is either imported clean fill or material brought ashore from either the dredging of the shipping channel or from the formation of the revetment batter slope. Note the channel sediment was tested in areas known for the highest potential concentration of contaminants. Of all metals analysed, the highest concentrations were well below DGVs (ANZG, 2018) (Leonard et al., 2020).

The area of permanent occupation at Sulphur Point from piles associated with the new wharf structures (piles) are 291 m^2 for Stage 1 and 105 m^2 for Stage 2.

The piles within the construction at extension to Mount Maunganui wharf will permanently occupy an area of benthic habitat of 322 m^2.[68]

The area of occupation for the seawall toe beyond the reclamations and rock revetment under the wharf is 20,977m^2 or 2.1ha at Sulphur Point Wharf and 18,803m^2 or 1.88ha at Mount Maunganui Wharf – total being 39,780m^2 or 3.98ha.

[68] Number of piles 464, diameter 0.94m^2.

Installation of mooring and breasting dolphins will involve permanent occupation of 92 m^2 of benthic habitat.[69]

At Butters Landing, the proposed jetty will occupy an area of benthic habitat of 5 m^2 [70] whereas the penguin ramp will occupy 1 m^2 of benthic habitat (4 piles at 0.5 m^2).

In summary, reclamation will cover up to 3.58 Ha and permanent benthic occupation up to 3.98 Ha with a combined total of approximately 7.56 Ha. Noting both the reclamations and benthic occupation areas are conservative values to cater for final design of the wharf apron width and some common area is included in the figures for both areas.

The assessment at the Stella Passage scale indicates 3.66 Ha (3.39 %) of Stella Passage benthic habitat will be reclaimed or permanently occupied. The assessment scale at the southern Te Awanui (**Error! Reference source not found.**) will result in 0.1% of benthic habitat loss. With High ecological values, and a magnitude of effect of Low at both scales (Table 5)[71] the level of the effect is assessed as **Low** (Table 6).

7.1.3 Mortality and disturbance of benthic invertebrates within the areas of reclamation, permanent occupation and dredging.

We conservatively assume that the entire benthic community (invertebrates and macroalgae) will perish within the proposed dredge sites, the areas of reclamation and areas of permanent occupation (e.g. piles and toe for seawalls).

Dredging is proposed to occur over 10.55 Ha and 1.5M m^3 (Stage 1: 6.1 Ha and 0.85 Mm^3 and Stage 2: 4.45 Ha and 0.65 Mm^3), of which 5.9 Ha (800,000 m^3) is already authorised under Resource Consent 62920 and the ecological effects of that component of the dredging have already been assessed and considered. Technically, this application is therefore for the ecological effects of 4.45 Ha of dredging or 700,000 m^3 of the 1.5 Mm^3 of dredging.

There will be a loss of any pipi within the area to be dredged and within the footprint of the proposed wharf extensions and reclamation. Tuangi (cockles)[72] and pipi found in the areas adjacent to the dredging will be subject to increased turbidity during dredging operations.

In summary benthic invertebrates will perish within 10.55ha (4.65 Ha not previously consented) of dredging, up to 3.58 Ha of reclamation and up to 4.05 Ha of permanent occupation, a total of approximately 16.51 Ha (which comprises 0.5 % of the Southern Te Awanui and 14.7 % of Stella Passage). Noting the total area does not double count the overlapping areas included in the individual conservative area calculations.

The existing diverse sessile communities attached to wharf structures (Table 3) will likely not survive in the reclamation areas due to the existing wharf structures being extended and replacement on the newly created harbour edge creating shading   The sessile organisms will naturally recolonise the new wharf edge (likely within 3 years), but it will be important to make sure that the new wharf structures have similar light and shade and similar hard surfaces (type

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[69] 12 piles per dolphin = 92m^2 occupation).

[70] Jetty 12 piles (6 x 0.8m diameter, 6x 0.6m diameter), penguin ramp 4 piles 0.5m diameter.

[71] EIANZ Guidelines state a Low Magnitude of Effect is defined as a minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR

Having a minor effect on the known population or range of the element / feature

[72] Tuangi have not been detected in the area of Stella Passage to be dredged, as they are primarily a subtidal species.

and area) as the existing wharf structures[73]. Natural restoration will occur on the new pile structures beneath the wharf extensions. with no long-term loss of biodiversity, so long as the same habitat is provided on a 1:1 basis.

The assessment scale for the wharf pile hard shore habitat is the Stella Passage and Southern Te Awanui (Figure 2). The existing wharf pile community has High ecological values. The magnitude of effect of construction of the new reclamation and wharf extensions is Low[74] (Table 5) in the short term, and Very Low (temporary) in the long term (Table 5). The overall level of effect is assessed as **Low** in the short term (1-<3 years) and **Very Low** (temporary) in the long term[75] (Table *6*)[76].

The assessment scale for the benthic soft sediment habitat is the Stella Passage and Southern Te Awanui (Figure 2). With High ecological values, and a magnitude of effects is Low (Table 5) [69] in the short-term (1-<3 years), and Very Low (Table 5) in the long-term (>3 years), with the level of the effect assessed as **Low** in short term and **Very Low** (temporary) in the long term[70] (Table 6).

The soft sediment benthic community within Stella Passage has already been subject to dredging (most recently 2015/2016), and there has been recovery of the community since then. We assume the same cycle will be the outcome of the proposed dredging, with a **Very Low** level of effect in the long term (>3 years). Effectively the dredging will reset the benthic habitat colonisation and restoration processes again.

This assessment considers that the soft shore benthic community has been previously disturbed and recovered with natural colonisation, and that these processes will be similar with the proposed dredging. The assessment (at both scales) takes the long-term view (>3 years) that the benthic habitat and communities will naturally be restored by the existing environment. Therefore, the magnitude of effect is negligible, and the level of effects is assessed as **Low** (Table 6).

7.1.3.1 Response/Recovery of Benthic Community Post Dredging

Battershill (2022a) stated that there was no difference in the diversity and relative abundance of channel floor benthic invertebrate species at sites in the Stella Passage previously dredged compared to nearby areas that have not been previously dredged. Battershill (2022a) expected that newly dredged areas will be rapidly colonised[77] through natural processes of recolonisation and rehabilitation by populations of benthic species from the adjacent channel floor habitat due to the high level of ecosystem connectively with areas outside of the proposed dredging area (including harbour/estuary and open sea), adequate supply of propagules from existing benthic organisms and high current flow assisting dispersion of larvae (Watson, 2016).

Some immediate effects on the channel floor benthos and down current of dredging sites will occur due to physical disturbance and removal of sediment (and associated biota) caused by

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[73] Noting the existing wharf piles are concrete and new wharf piles will be steel tubes – but both materials can be colonised by marine organisms.

[74] EIANZ Guidelines state a Low Magnitude of Effect is defined as Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns.

[75] Resulting from natural recolonisation processes.

[77] Para 67, Battershill 2022a.

the dredge and subsequent fall-out of sediment and shell debris. This effect is limited in extent (to the area to be dredged) (de Lange, 2024) and temporary, with recovery of soft sediment benthic habitat occurring over short time frames (1-3 years as a result of larvae of appropriate species located in close proximity and aided by recruitment in high current regimes) (Battershill, 2022a).

The studies of Blom et al. (1993) and pre- and post-dredging observations by Battershill (2022a) suggest that benthic community recovery will occur within 1-3 years of dredging. Recovery pathways are anticipated to involve a gradual reintroduction of the original species pool typically via spillover of species in adjacent habitats that have not been impacted, in addition to the processes of larval dispersal, settlement and recruitment. Battershill (2022a) concluded that recovery of soft sediment benthic habitats in dredged areas is likely to be rapid.

Lundquist et al. (2010) concluded that recovery of benthic communities is influenced by the degree of neighbourhood community connectivity which defines a benthic community's ability to persist in the face of disturbance. With respect to the proposed dredge areas for the current Project, the surrounding non-dredge areas will promote a rapid recovery due to community connectivity, a pool for spill-over effects, and larvae for settlement and recruitment in colonisation.

Based on the fast recovery (1-3 years) from previous dredging campaigns by the POTL, where dredging in the Stella Passage was conducted during outgoing tides, the dredge plume was quickly carried outside the harbour and dissipated, with the potential adverse effects of the proposed dredging campaign on seabed communities being minimal and relatively short lived.

As has been evidenced from past dredging campaigns, the effects on filter feeding organisms (e.g. smothering of gills from resuspended fine sediments) which comprise the larger proportion of benthic species in the proposed reconsenting area, will be minor and short term. Filter feeding species present are already somewhat influenced by fine sediment smothering events from storm runoff and these species have behavioural mechanisms to counter for temporary sediment flows.

Battershill (2022a) states that the species (soft sediment and hard substrate) assemblages, diversity and abundance in Te Awanui are relatively stable, despite a number of capital dredge campaigns in the past. The benthic community in the areas that have previously been dredged (for example as part of the 2015/2016 capital dredging campaign), will be removed again through the Project and the natural processes of recolonisation and rehabilitation will be reset and begin again (occurring over a likely 1-3 years to return community composition similar to pre-dredging).

7.1.4 Coastal Edge

The coastal edge of the Stella Passage and the southern Te Awanui has been highly modified with historic reclamations and other activities. The current works within Stella Passage will extend the already modified shore further into the deeper central harbour. It will be important to ensure that the new wharf edges provide the same habitat type (light, shade, pile area, pile type) as the existing wharves to enable the natural recolonisation of hard shore species and have no permanent biodiversity loss (as remedy or mitigation).

This assessment considers that hard shore harbour edge has been previously disturbed with location of wharves and reclamations and it has recovered with natural colonisation, and that these recovery processes will occur again after the proposed developments. The assessment at Stella Passage scale takes the long-term view (>3 years) that the hard shore sessile habitat and communities will naturally be restored by the existing environment, assuming the new wharf edges have similar composition to that proposed to be superseded by the new wharfs. With this remedy/mitigation in place, the magnitude of effect is assessed as **Negligible**, and the level of effects is assessed as **Very Low** (Table 6).

The effects on the Southern Te Awanui coastal edge assessment is the same as the Stella Passage scale assessment, but involves a smaller proportion of coastline.

7.1.5 Shading from wharves and dolphins

The wharf extensions will shade the seabed and water column over an area of 24,853 m^2 comprising approximately 11,716 m^2 at Mount Maunganui Wharf, 12,975 m^2 at Sulphur Point Wharf, and 162 m^2 at Butters Landing.

The reduced light conditions could be unsuitable for many species of algae. However, shade-tolerant algae and marine invertebrates will be able to colonise the shaded revetments and pile structures over time.

The existing wharf piles have complex 3-dimensional community composition of sessile organisms. Communities are similar on both sides of the harbour (i.e. Sulphur Point and Mount Manganui wharves) and are typical of harbour environments in northern New Zealand (Battershill, 2022a). It is expected that similar communities will develop on the piles of the wharf extensions and other structures included in this development. The effect of additional shading by the wharf extensions will alter the soft-sediment benthic habitat to a small degree through light (affecting approximately 2.5 Ha, which is 0.07 % of the southern harbour and 2.2 % of the Stella Passage) but the habitat will, in time, be colonised by a similar suite of organisms as those that are currently present underneath wharf structures.

Laboratory experiments indicate that light affects fish growth through a better food conversion efficiency with exposure to more light (Boeuf & Le Bail, 1999). However, it is not known whether fish growth rate is influenced by light in the natural environment.

In generally, fish larvae in laboratory studies need a minimal threshold light intensity to be able to develop normally and grow. This is likely related to the ability to localise, catch and ingest prey/food. A few fish species are able to adapt to low light and can develop and grow at very low light intensities. Generally, long daylength improves larval rearing quality. The synergistic effect of `food availability-daylength' appears to be determining at this early stage (Boeuf & Le Bail, 1999).

In older fish, there is very little research and information about the influence of light `quality' but more about intensity and much more about photoperiod. Light intensity effects are not likely to be an important factor for adult growth. Fish, being mobile, can avoid habitats that are light limited (e.g. under wharves), meaning that the shading of pelagic habitats by wharf structures will have negligible effects on fish.

The assessment scale is the Stella Passage (**Error! Reference source not found.**). The effect of shading on high ecological marine values (algae, invertebrates and fish) is expected to have a **Low** magnitude of effect (Table 5), resulting in a **Low** level of effect (Table 6).

The effect of shading by the wharf extensions at the Southern Te Awanui scale on high ecological marine values (algae, invertebrates and fish) is expected to have a **Negligible** magnitude of effect (Table 5) , resulting in a **Very Low** level of effect (Table 6).

7.1.6 TSS/Turbidity from Dredging

Average natural turbidity in Te Awanui was found to be <5 NTU in all parts of the harbour where dredging may occur. The largest natural turbidity events occurred around 10 % of the time during rare extreme rainfall events with the duration being between 20-30 hours (Bryan et al, 2014).

For the current project de Lange concluded that TSS would be at background levels in Te Awanui outside the mixing zone / monitoring area (which is 500m upstream of the dredge to 600m south of the dredge using the BHD and 500m using at TSHD) de Lange, 2022).

Within this mobile mixing zone, the plumes from dredging would be of short duration (<15 minutes) and would involve medium to low turbidity compared to natural turbidity. Peak turbidity close to the dredge overflow may be as high as experienced in rare extreme rainfall events, but the turbidity levels would decay rapidly within the mixing zone (de Lange, 2022). Using a TSHD, the turbidity controls allow for no overflow on the flood tide, but 15 minutes of overflow on an ebb tide per load.

Modelling and field observations suggest that TSS reaches background concentration before any affected flow reaches the boundary of the mixing zone (200m upstream of the dredge to 600m south of the dredge). de Lange (2022) concluded that the turbidity event associated with the dredging would have similar or lower effects than that from natural processes that occur in the harbour.

Based on this modelling, it is evident that the TSS plumes generated during dredging do not reach Te Paritaha (pipi bed).

If necessary, the dredging methodology can be altered while the dredge is operating to reduce the suspended sediment to just the near-bed suspension produced by the cutting head (which does not disperse very far – i.e. 10s of metres at most).

Dredging carried out in 2015 in the Stella Passage involved use of a TSHD and a back-hoe dredge BHD[78]. During that dredging campaign, TSHD dredging was only permitted during an outgoing tide, with limited overflow of dredged material. In the current proposed dredging, it is proposed that dredging is permitted on a flood tide with no overflow, whereas overflow of dredged material is permitted for 15 minutes per loading cycle on the ebb tide, which minimises the creation of turbidity. Turbidity measurements will occur during both tides, with a 15 NTU limit between background and 200 m downstream of the active dredge. This programme is proposed to balance the work across the full tide spectrum and minimising the duration of the dredging campaign.

The duration of any dredging is largely dependent on the size of the dredging equipment used and whether the vessel works 24 hours seven days a week. Each dredging campaign (likely three being Stage 1 down to 14.5 m, Stage 2 down to 14.5 m, entire dredge area down to 16 m)

[78] Reference to dredge methods section in AEE section 6.1

required for the various stages of the Stella Passage development should take approximately 6 months[79].

Due to the shallow draft requirement, a small TSHD similar to the "Albatros" (currently contracted to the Port of Tauranga Limited for maintenance dredging) or a medium sized TSHD with a 3,000 – 6,000 m^3 hopper will likely be used in the current dredging proposal. The small dredge limits the potential for turbidity to be caused, which is also a precautionary measure.

A further control is that the TSHD will be fitted with a green valve (or similar technology) to reduce turbidity caused by overflow.

As the area to be dredged is small, mitigation techniques such as alternating the dredging of different locations to minimise potential turbidity effects cannot be used.

However, the shallow draught requirement for the vessel will mean a small dredge will be required. The use of a small dredge limits the potential for turbidity to be caused in a short time frame and can be seen as a more precautionary approach.

Due to the physical disturbance of the dredge on the seabed, there will be some immediate effect on the channel floor benthos in the dredge area and down current. However, hydrodynamic and geomorphological studies suggest that no long-term adverse effects are expected (de Lange, 2024). Previous dredge campaigns have shown that sediment resuspension is likely to be moderate in extent, not above baseline turbidity or TSS, and of a short duration (de Lange, 2024).

Bryan *et al* (2014[80]) reviewed data from an array of turbidity sensors within the port area to determine the "natural" variation in turbidity: this may include contributions of suspended material from storm-water discharges into Te Awanui/Tauranga Harbour. This study found the highest average natural turbidity levels at 5 NTU within Stella Passage, compared to 3.5 NTU in the Ōtūmoetai Channel, <2 NTU in the Entrance, and 3-4 NTU elsewhere. High turbidity events (>5 NTU) occurred ~10 % of the time and typically lasted for 20-30 hours.

For the current project de Lange (2024) concluded that TSS would be at background levels in Te Awanui outside the consented mobile mixing zone, which is 200 m upstream of the dredge to 600 m south of the dredge.   (Montaño, 2024) concluded from her modelling that dredge plumes are confined to the channels and do not extend over Te Paritaha or into Waipu Bay.

Material to be dredged has been tested for contamination and found to not contain contaminants above DGV concentrations (Leonard et al., 2020).

Marine fish and tuna are expected to not be affected by suspended sediment, because they are inherently mobile, and have tolerance of turbid conditions.

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[79] Assuming limited overflow

[80] Bryan KR, Douglas E, Pilditch CA, & Cussioli MC, 2014. *Setting water quality limits and monitoring turbidity for the Port of Tauranga. Part A: Preliminary Investigation*. ERI report 25. Environmental Research Institute, Hamilton, New Zealand. 22 pp + appendix

7.1.7 Effects on benthic invertebrates, fish, macroalgae and seagrass of TSS/Turbidity generation from construction of revetments, reclamation and installation of new piles

The turbidity limits (Table 12 in Section 7.1.1) for dredging will be the same as for the creation of the revetment involving excavation and armouring the batter slope with clean rock material.

In order to form the reclamations, dredged material will require dewatering on shore. Turbidity can be caused at the outfall of the settlement pond used to dewater the sand as it is pumped ashore. The ponded water can be managed by installing pond outlet pipes at a height that encourages soakage and enables the smaller fraction sized particles time to settle before discharging. It is proposed to use filter screens and floating booms, if required, to limit the turbidity caused by any discharged water from the pump ashore operations. As the distance between the dredge areas and the reclamations is short, less water will be required to lubricate the pump line used to transport the sediment slurry.

Any dewatering of the material brought ashore will be done to limit increases in turbidity to less than 15 NTU above background levels beyond 250m from the construction site (with background levels being measured 500m upstream from the construction site). The materials excavated and brought ashore will be similar to those previously dredged from the channels and these turbidity controls mirror previous dredging consents.

As with the material bought ashore through forming the batter slope all material brought ashore will be landed behind the construction site so that any resulting discharge will be contained within the construction site. The location of the discharge within the footprint of the construction area will result in any discharge to water occurring in the same area being modified and lessen any detrimental effects to the immediate surrounding area. Material will only be moved and stockpiled once sufficiently dry so as to not cause further discharge to the environment.

TSS generated from piling is expected to be very low (directly around the pile) and temporary.

The substrate to be disturbed is a mix of predominately silts and sands.

TSS/Turbidity effects on bivalve benthic invertebrates

Increased turbidity from dredging due to resuspension of fine silt particles in the benthic sediment can lead to physical degradation of the water quality and physical effects on biota through smothering and/or light attenuation (for example on seagrass and shellfish). This risk is reflected in the current consent conditions which are primarily designed to monitor and control turbidity.

In their laboratory tests of bivalve response to relationship between total particulate matter (TPM) and turbidity Teaioro (Teaioro, 1999), revealed that pipi had impaired feeding efficiency at TPM concentration >39 mg/L for the high organic experiment and >20 mg/L for the low organic experiment. Teaioro’s sublethal growth efficiency trigger values are lower than the peak TSS experienced by the pipi population at Te Paritaha (Centre Bank) during maintenance and capital dredging (Coppede Cussioli, 2018, (Montaño, 2024)).

Table 9: Laboratory trial results of the effect of TSS on marine invertebrates present in the Stella Passage

Species	Effect detected	TSS concentration and duration of exposure at which effects were measured	Reference	Presence in Te Awanui
Pipi - (*Paphies australis*)	Reduced condition	75 g/m³ (after exposure >13 days)	Hewitt et al., 2001	Common
Pipi - (*Paphies australis*)	Reduced feeding efficiency[81]	>20 g/m³ (low organic exp.) >39 g/m³ (high organic exp.) (after exposure >8 hours)	Teaioro, 1999	Common
Horse mussel - (*Atrina zealandica*)	Reduced condition	80 g/m³ (after exposure >3 days)	Ellis et al., 2002	Present, but sparse
Tubeworm - (*Boccardia sp.*)	Reduced feeding rate	80 g/m³ (after exposure >9 days)	Nicholls et al., 2003	Common
Wedge shell - (*Macomona liliana*)	Reduced survival	300 g/m³ (after exposure >9 days)	Nicholls et al., 2003	Common
Cockle - (*Austrovenus stutchburyi*)	Reduced condition	400 g/m³ (after exposure >7 days)	Hewitt et al., 2001	Common

Modelling by Montaño (2024) shows that the extent of surface and seabed plumes at Te Paritaha is zero or negligible (one occasion during 130 days of modelling reached 0.2 mg/L (or 200 g/m^3) [82] during the largest spring tide modelled at peak high tide, which is above the effects threshold of 75 g/m^3 after an exposure period of >13 days (Hewitt et al., 2001), however the modelled exposure period was significantly shorter (only 10-20 minutes)[83]. Therefore, the adverse effects at this exposure concentration and time frame are expected to be negligible.

Pipis can only feed efficiently at very low sediment concentrations. Pipis have a low tolerance level to turbidity (Teaioro, 1999). The laboratory results of Teaioro (1999) concluded that as there were no dead bivalves reported during their experiments, even though pipi were exposed to suspended sediment for eight hours, this indicates that these bivalves can recover from periodic exposure to elevated turbidity for short periods. Since resuspended sediment caused by dredging operations typically remains in the water column for less than 8 hours it can be assumed that these bivalves can fully recover after being exposed to this type of resuspension.

Tuangi (cockles) and pipi found in the areas surrounding the dredged areas (but outside of Te Paritaha and Whareroa marae foreshore) will be subject to short term increased turbidity during dredging operations. The turbidity effect on water quality is deemed to be transient (de Lange, 2024) and evidence indicates that ecological effects will be negligible.

The effect of the discharge of sediment on marine organisms and habitats relates to both suspended sediment and deposited sediment. Effects on organisms are a factor of volume of sediment (concentration of suspended sediment and depth of deposited sediment) and duration of exposure. The significance of these effects also depends on the nature and values of the existing receiving environment.

[81] Measured as scope for growth.

[82] 1g/L is 1000 g/m^3

[83] Pers comm. Willem de Lang 20/01/2024.

Ellis et al. (2002) conducted an experiment on the suspension feeding horse mussel (*Atrina zelandica*) to determine the effect of short-term elevations in turbidity levels, and field experiments in the Mahurangi Harbour to investigate long-term effects. Both background and storm-related suspended sediment rates were assessed. The laboratory study found that the clearance rate of suspended sediment in horse mussel decline with turbidity concentration beyond 120 FTU[84]. In upper reaches of estuaries, horse mussels showed signs of low physical condition and decreases in horse mussel with reduced condition were detected after exposure to elevated levels for only 3 days (Ellis et al. 2002). The study provides clear evidence that high loads of suspended sediments can have negative effects on the physiological condition of filter feeding taxa, such as horse mussel, and areas of higher deposition will most likely exclude or remove colonisation of these species.

The modelled TSS concentration for the dredging and construction activities is below the threshold for ecological effects on bivalves (below 75 mg/L, exposure >13 days[85]) and the duration of exposure is temporary/short term in duration. The TSS concentration and duration of exposure from dredging for this project is below the avoidance threshold modelled of 80 mg/L and as such bivalves will not be adversely affected.

TSS/Turbidity Effects on Fish

There are few published studies on how estuarine and marine fish respond to \TSS and less is known about behavioural thresholds. In situations where concentrations of TSS are not lethal, pelagic, demersal and benthic fish are likely to avoid (swim away from) the area with elevated TSS (Page, 2014). Avoidance of the sediment plume by pelagic, demersal and benthic species is likely to occur where concentrations of TSS are predicted to reach 100 mg/L (Page, 2014).

The TSS concentration and duration of exposure from dredging for this project is below the avoidance threshold of 100 mg/L and as such fish will not be adversely affected.

TSS/Turbidity Effects on Seagrass

The run-off of nutrients and sediments into estuarine and coastal areas as a result of human activities on land, leading to increased turbidity and potentially increased sedimentation, is the greatest threat to seagrass due to a reduction in the amount of photosynthetically available radiation. There are no published thresholds for TSS effects on seagrass.

TSS from dredging for this Project will be low level and temporary compared to the existing background activities which result in TSS and turbidity in the harbour.

Summary

The assessment scales are the Stella Passage and the southern Te Awanui (Figure 2). With high ecological values, and a magnitude of assessment of **Negligible** (Table 5), the level of the effect of TSS on benthic macroinvertebrates, macroalgae, seagrass and fish is assessed as **Very Low** (Table 6) at both scales.

[84] FTU = formazin turbidity units

[85] Apart from one occasion during the 130 days of modelling, where TSS reached 0.2 mg/L during the largest spring tide modelled.

7.1.8 Deposited sediment from suspended sediment generation from sediment disturbance activities

The deposition of sediment can occur from activities in the CMA that generate suspended sediment which then falls to the benthic seabed and deposits. Smothering of marine biota by sediment is a potential effect related to the deposition of suspended sediment particles arising from the action of the dredge.

<u>Dredging</u>

The deposition of suspended sediment generated by the dredge is predicted to occur within the mobile mixing zone of the dredging and will therefore fall on areas already disturbed by dredging, and thus will not have additive effects on the benthos. Effects on benthic organisms of deposited sediment are a factor of volume of sediment depth of deposited sediment and the duration of exposure.

As stated above in 4.12, the deposition of suspended sediment in the Stella Passage from dredging, will be sand on sand, and there is less scientific literature about the marine benthic ecological effects of depositing sand on top of sand.

Most marine invertebrates can tolerate the deposition of sediment for up to three days by isolating themselves from environmental stressors (e.g. bivalves close their valves, other invertebrate cease feeding) (Nicholls et al., 2009). Many organisms are able to slow their metabolism and temporarily reduce their reliance on oxygen by changing their metabolic pathway from aerobic to anaerobic during this time. Less sensitive organisms may tolerate sediment deposition for a longer period before adverse effects begin to occur (Lohrer et al., 2006).

Within the mixing zone (200m upstream of the dredge to 600m south of the dredge) (de Lange, 2024)), the benthic organisms are common species that are adapted to regular sedimentation events.

It is expected that effects of sedimentation will be negligible with the turbidity management controls (see draft proposed conditions) in place to minimise TSS beyond the mobile mixing zone (de Lange, 2024). There is expected to be no detectable deposition of suspended sediment on Te Paritaha or the Whareroa marae foreshore (de Lange, 2024).

The assessment scales are the Stella Passage and the southern Te Awanui (Figure 2). With high ecological values, and a magnitude of assessment of **Negligible** (Table 5), the level of the effect of deposited sediment is **Very Low** (Table 6) at both scales.

7.1.9 Sediment and Water Quality

Chemical analyses of the sediments that are likely to be dredged and disturbed during the proposed campaign show that metals, PAHs, and OCs concentrations are below ANZG DGV concentrations of concern. These concentrations have remained below DGV for a number of years (based on extensive review provided by de Lange, 2022).

There would be negligible contamination of water quality due to low concentrations of contaminants in disturbed sediments, even during dredging activity (de Lange, 2024). Given the high degree of water flow and exchange/replacement on each tide, the longer-term effects on water quality from sediment bound contaminants are likely to be negligible.

The assessment scales are the Stella Passage and the Southern Harbour of Te Awanui (Figure 2). With high ecological values, and a magnitude of assessment of **Negligible** (Table 5), the level of the effect of contaminated suspended sediment from dredging is **Very Low** (Table 6) at both scales because of the contaminant levels being significantly below ANZG DGVs.

7.1.10 Incursion of Invasive Marine Species

Invasive species are commonly introduced into new areas of marine environment through being carried on marine vessel hulls or ballast water. In the current project, any construction related vessels entering the Stella Passage Development area will need to be certified as "clean" in terms of marine biosecurity.

7.1.11 Underwater Noise and Vibration

Pile Driving

It is estimated that approximately eight piles, either pre-stressed concrete or steel tubes, will be required for every 6m of berth length to support the wharf deck and the resulting imposed loads. The pile diameters will vary to meet the loading requirements and will be similar to that used in the 2013 extension which ranged from 785mm to 914mm diameter.

While driving the entire length of pile creates more noise it provides added skin friction and therefore better load carrying characteristics. Pile driving is unavoidable for the type of construction required for heavy duty wharves. The piles are driven in the order of 30m into the ground, depending on site conditions, until the design end bearing resistance is obtained. At Sulphur Point the piles will be driven into the underlying dense sand layers which varies in depth due to the natural variability in suitable geological material. Vibratory piling (compared to impact piling) will be prioritised during construction.

Marine mammals

The assessment of effects of the project on marine mammals indicates that bottlenose dolphins, killer whale and New Zealand fur seals could be occasionally present in Te Awanui but that Te Awanui is not a significant habitat for any marine mammal species (see McConnell (2025) for assessment of effects on marine mammals).

McConnell (2025) states (in McConnell's Section 3.1) piling activities will adhere to the following controls is required during all piling activities:

- Piling equipment will be selected (i.e., hammer type, hammer size and driving force) and operated (i.e., hammer energy/power level) to ensure underwater noise is minimised to the extent practicable while still achieving construction goals;
- Piling equipment will be regularly maintained, including lubrication and repair;
- The duration of piling activities will be minimised to the extent practicable[86];
- Restricted hours of operation will be observed when appropriate;

[86] Noting that oftentimes a balance will need to be struck between piling duration and hammer type/size/force. These decisions should always be taken with the over-riding principle of minimising underwater acoustic noise.

- The use of cushion blocks is mandatory for all impact pile driving[87];
- The use of bubble curtains is mandatory for all impact pile driving[88]; and
- Impact piling shall not result in more than 8,000 strikes per day.

McConnell (2025) also recommends soft starts for piling activities (section 3.7).

McConnell (2025) notes that if recommended mitigations are adopted with respect to underwater noise, that the likelihood of adverse effects on marine mammals is **Moderate**, with the magnitude of effect reducing to **Minor** with the proposed mitigations in place (see Table 9, SLR 2025).

Fish

The response to sounds by fish might range from no obvious change in behaviour to temporary displacement from their normal locations. There may be no effects or substantial effects on a population (Popper & Hastings, 2009).

Even though the noise from pile-driving might be obvious to the human ear, this is not the case for all species of fish (Sorensen & Skyt, 1980). It is suggested that fish with swim bladders may elicit avoidance reactions, at less than 30m from the piling sound source. It is not likely that the noise from pile driving will produce physical injuries to any fish species ((Sorensen & Skyt, 1980).

There are numerous complexities with pile driving that might impact the effects on fish (Popper and Hastings, 2009). Different types of piles (steel or concrete) have different response characteristics. It is not known whether such characteristics will cause a difference in effects on fish. It is also unknown whether there is a cumulative effect from being exposed to multiple pile strikes nor whether any cumulative effect would be altered by changing the time between strikes. The effect might result in death, tissue damage, and/or hearing loss. However, very little is known about effects on fish from pile driving (Popper & Hastings, 2009).

Critical literature concludes that very little is known about effects of pile driving and other anthropogenic sounds on fishes, and that it is not yet possible to extrapolate from one experiment to other signal parameters of the same sound, to other types of sounds, to other effects, or to other species (Popper & Hastings, 2009). Little is known about the effect of pile driving on New Zealand tuna. However, as downstream eel migrations normally occur at night (when piling not occurring), tuna will be unaffected in their migrations to the ocean (Schicker et al., 1990).

Some species of fish, such as gurnards, produce sound to communicate with each other. These vocalisations could be masked during pile driving.

Even though the noise from pile driving may be very audible to the human ear, this is not the case for all species of fish (Sorensen & Skyt, 1980).

The uncertainty as to effects on fish species is allayed by the fact that the piling noise will be localised to an area that is not recognised in the Regional Coastal Plan as an important fish habitat, the piling works will be temporary and limited to daytime, and will occur in an area where there are not any populations of rare/threatened fish species that could be displaced.

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[87] Cushion blocks consist of blocks of material atop a pile during piling activities to minimise the noise generated during impact hammering. Materials typically used for cushion blocks include wood, polymer, nylon or micarta.

[88] Contractor to provide and operate bubble curtain technology. On a similar project in Wellington Harbour they reduced the overall sound levels by 5 dB which equated to a reduction of 15-20 dB when results were weighted for the hearing range of high frequency cetaceans (Warren, 2021).

Sharks

Sharks are expected to avoid the Port area in periods of elevated noise such as piling. As such, the effect on shark species (including great white shark) is expected to be low.

Invertebrates

Some invertebrates, such as decapod crustaceans, are reported to be sensitive to low frequency underwater noise (Boeuf & Le Bail, 1999). Sessile invertebrates may be affected by piling noise as they have limited ability to move/avoid the noise.

The invertebrates present in Stella Passage (both benthic soft sediment and hard shore species) are ubiquitous and common and any adverse effect on individuals from piling noise would not have adverse effect on populations or biodiversity values.

Green turtle

Little is known about the effect of noise on green turtle. It is expected that there could be some avoidance behaviour during construction noise. Given the rarity of this species occurring in Tauranga Harbour and Stella Passage, the effect on this species is considered to be negligible.

Summary of underwater noise and vibration

The assessment scales are the Stella Passage and the southern Te Awanui (Figure 2) with mitigation/management procedures in place. McConnell (2024) states marine mammals will be protected with the mitigation/management measure in place. With respect to fish we assume that they will have the ability to move away from (avoid) piling noise, whereas there may be adverse effects on common sessile invertebrates. Night time eel migration to the ocean will be unaffected as piling will occur during day light hours only. With high ecological values, and a magnitude of assessment of **Low** (Table 5), the level of the effect of underwater noise is **Low** (Table 6) at both scales.

7.1.12 Cumulative effects

Cumulative effects on marine ecology in the Stella Passage and the southern Te Awanui have occurred due to non-POTL and POTL activities. Non-POTL activities include historic and ongoing poor land use practices (leading to sedimentation[89] which influences the colonisation of mangroves and decrease in seagrass cover) and coastal developments, occupation by marina structures, discharges from marinas, stormwater discharges, armouring/hardening of shore edges and fishing (and potentially overfishing). BOPRC conclude that the biggest issue for the coastal area of Tauranga Moana is the impact from our actions on the land[90]. POTL activities include dredging[91], reclamation, permanent occupation and shading of the benthic habitat.

<u>Capital Dredging on Benthic Communities</u>

Historical capital dredging for the POTL (and its predecessors) has involved 5.5 Mm^3 from Maunganui Roads and Stella Passage between 1970 and 1989[1]. The current proposal is for

[89] Infilling of harbours and estuaries (sedimentation) is a natural process which is often exacerbated by poor landuse practices.

[90] BOPRC State the Environment Report, 2019.

[91] Related, in part, to sedimentation of the harbour, reducing channel depths.

10.55 ha (or 1.5 Mm^3) capital dredging in Stella Passage. Consent has previously been approved for the dredging and disposal of 5.9 ha (800,000 m^3).

Dredging involves a temporary effect as the subtidal benthic communities will periodically “reset” following a natural pattern of recolonisation and succession in the dredge and disposal areas (likely recovering to similar communities by least 3-5 years).

The cumulative effect of capital dredging on benthic invertebrate communities is a Low level of effect due to the rapid recolonisation of assemblages (High ecological values combined with a **Low** magnitude of effect).

Reclamation

Historical reclamation for the POTL (and its’ predecessors) has involved 69.7 ha at Sulphur Point, and 36 ha adjacent to Mount Maunganui side of the southern harbour. The marine ecological values within those areas would have been destroyed. The current proposal is for 3.58 ha of additional reclamation, 1.81 ha at Sulphur Point and 1.77 ha at Mount Maunganui side of the harbour (an increase of 2.6% and 4.9% to the existing reclamations respectively).

The cumulative effect of reclamation on marine ecological values is assessed as a **Low** level of effect at the Stella Passage and southern Te Awanui scale. The proposed reclamation is a small area relative to the entire Southern Harbour and to the existing reclamation (High ecological values combined with **Low** magnitude of effect).

Permanent Occupation

Permanent occupation of the benthic marine environment is currently 1,050 m^2 at the Mount Wharf, and 415 m^2 at the Sulphur Point Wharf. The additional benthic habitat permanently occupied by piles for wharf and dolphins (and some ancillary structures) is 420 m^2 at Mount Wharf and 397 m^2 for the Sulphur Point wharf[92] (an increase of 40 % and 93 % of the existing permanent occupation respectively).

The cumulative effect of permanent occupation on marine ecological values is assessed as a **Low** level of effect at the Stella Passage and southern Te Awanui scale as the scale of proposed occupation is relatively small (and in separate discrete areas) compared to the existing permanent occupation (High ecological values combined with Low magnitude of effect).

Maintenance Dredging

Historically, maintenance dredging (of previous capital dredged areas), has occurred at the Entrance Channel, No. 2 Reach, Cutter Channel, Maunganui Roads, and Stella Passage from 1988 to present day. Maintenance dredging effects marine ecology by way of halting the natural recovery process of the benthic habitat and effectively resetting the benthic habitat to ‘day one’ post dredging.

The cumulative effect of maintenance dredging on benthic invertebrate communities is a **Low** level of effect at the Stella Passage and southern Te Awanui scale due to the rapid

[92] Estimate based on previous and current designs and subject to final design.

recolonisation of assemblages (High ecological values combined with a Low magnitude of effect).

Turbidity and Sedimentation

The effects of TSS and sedimentation is at the scale is at the Stella Passage and southern Te Awanui (Figure 2). With high ecological values, and a magnitude of assessment of Negligible (Table 5) [93], the level of the effect of TSS and sedimentation on benthic macroinvertebrates, macroalgae, seagrass and fish is assessed as **Very Low** (Table 6).

Shading

The existing area of shading beneath wharves and structures are 19,910 m^2 for Sulphur Point and 29,138 m^2 for Mount Wharfs and structures. The new wharf extensions will add a further 12,975 m^2 at Sulphur Point and 11,716 m^2 for Mount Wharf and Dolphins[2]. The new Mount Maunganui and Butters Landing minor structures will add a further 162 m^2 to the areas shaded[2]. The overall increase in shading is 37 % for Mount Wharf and structures and 29 % increase at Sulphur Point Wharf at the Stella Passage scale.

The cumulative effect of shading by wharves limiting light to algae, invertebrates and fish is considered a **Low** level of effect at the Stella Passage and southern Te Awanui as mobile species can avoid low light areas and sessile species that are adapted to lower light levels will colonise (High ecological values combined with a Low magnitude of effect, Low level effect; see Tables 4 and 5).

Cumulative effects conclusion

In the current project, the effects that are proposed to occur are dredging, reclamation, permanent occupation, shore-line modification, loss of biota, shading and noise and vibration. Separately, these effects are assessed as having very low to low levels of effect on marine ecological values in Stella Passage and the southern Te Awanui, and when these effects are considered to occur in combination, in addition to historic activities (port and non-port related) and potential future activities that impact on the marine ecological values, the overall composite cumulative effect is considered to be a **Low** magnitude of effect. The ecological functioning and biodiversity of the Stella Passage and the southern Te Awanui will not be significantly affected by the proposed activities (over a three-year natural recolonisation period post construction), although the additional permanent losses of area of CMA are a negative outcome.

The assessments spatial scale is the Stella Passage and the southern Te Awanui (Figure *2*). Overall, cumulative effects are assessed as a **Low** magnitude of effect (Table 5), from the aggregation of **Very Low** and **Low** levels of effects from a number of activities, both current and historic, both POTL related and non-POTL activities, including dredging, reclamation, permanent occupation, shading and reinforcing shoreline modification, sedimentation etc (**High** ecological values combined with a **Low** magnitude of effect).

[93] EIANZ Guidelines state a Moderate Magnitude of Effect is defined as Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed.

7.2 New Zealand Coastal Policy Statement (2010)

NZCPS Policy 10

1. *Avoid reclamation of land in the coastal marine area, unless:*
   b. *the activity which requires reclamation can only occur in or adjacent to the coastal marine area*

The reclamation proposed is necessary to support the proposed new wharf areas and must be located in the CMA. The reclamation could not be located outside of the CMA.

NZCPS Policy 11a

avoid adverse effects of activities on:

- i) *indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists;*
- ii) *taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened;*

Given the presence of seagrass (*Zostera muelleri* subsp. *novazelandica*) which is an At Risk (Declining) taxa (de Lange et al., 2013) and marine mammals[94] that are occasionally or seasonally present in the Harbour (orca, killer whale *Orcinus orca* Threatened (nationally critical) and bottlenose dolphin *Tursiops truncatus* (Threatened (nationally endangered) (McConnel, 2025)[95], Policy 11a is relevant to considerations..

In addition, Longfin eel (At Risk – declining) (tuna) migrate at night time through the Stella Passage enroute to the ocean during completion of the life cycle. Tuna will not be affected in their migration from piling noise as this activity only occurs during day light hours. Tuna are also tolerant of turbid water and will be unaffected by any increase in TSS from dredging works. There effects are avoided, which is consistent with Policy 11a.

Effects on seagrass will be avoided by way of the project siting, and through the type of equipment used for the dredging and dredging on incoming tides. The dredging methodology will ensure TSS does not reach the seagrass beds adjacent to Whareroa marae, the wider Waipu Bay or the Ōtūmoetai shoreline, hence avoiding adverse effects, consistent with policy 11 a).

NZCPS Policy 11 (b)

To protect indigenous biological diversity in the coastal environment:

(b) avoid significant adverse effects and avoid, remedy or mitigate other adverse effects on:

[94] Marine Mammals are excluded from this report and are covered separately by McConnell, 2024. Assessment of Effects: Marine Mammals. Stella Passage Development, Port of Tauranga Ltd.

[95] Baker et al., 2019. Conservation status of New Zealand marine mammals, 2019. New Zealand Threat Classification Series 29, Department of Conservation, Wellington.

i) areas of predominantly indigenous vegetation in the coastal environment.

Given the presence of seagrass and mangrove forests in southern Te Awanui, Policy 11b is relevant to considerations.

All adverse effects on seagrass are avoided as per policy 11 a) above. Mangrove forests will not be affected by the dredging/TSS generation as they are remote to the dredge and disposal areas.

ii) habitats in the coastal environment that are important during the vulnerable life stages of indigenous species,

In Te Awanui, sandbank areas for pipi recruitment and settlement and seagrass beds for fish nursery grounds trigger policy NZCPS Policy 11(b). The modelling of the TSS from dredging shows that the TSS remains within the mixing zone (200m upstream of the dredge to 600m south of the dredge) and does not reach Te Paritaha.

iii) ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries[96]*, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh*.

Southern Te Awanui contains intertidal areas, rocky reef habitats, seagrass and saltmarsh. The areas affected by the TSS from dredging are limited to the mobile mixing zone (200m upstream of the dredge to 600m south of the dredge) and not in proximity to intertidal, of rocky reef habitats, seagrass or saltmarsh. The rocky reefs around Mauāo reef are the only coastal rocky reef headland on the mainland between Coromandel Peninsula and Waihau Bay.

iv) habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes.

In Te Awanui, the Te Paritaha pipi beds and rocky reefs for kaimoana harvesting are relevant to this policy. As above, the TSS from the dredging plume does not extend into Te Paritaha. In addition, rocky reefs are distant from the mobile mixing zone (200m upstream of the dredge to 600m south of the dredge) and therefore not affected.

vi) ecological corridors, and areas important for linking or maintaining biological values identified under this policy.

There is evidence of effective ecological corridor functionality in terms of stable ecosystems within the sub estuary systems that feed into and are flushed through Te Awanui.

Mauāo is settling areas for juvenile crayfish, pāua and kina and serves as an ecological corridor between Motuotau Island, Motiriki and Mauāo.

These functions will not be impeded by the project.

[96] Vulnerable ecosystem (Holdaway et al., 2012)

Policy 23

NZCPS policy 23(1)(d) requires that when considering discharges to water in the coastal environment, particular regard must be had to avoiding significant adverse effects on ecosystems and habitats after reasonable mixing.

The project avoids significant adverse effects on ecosystems and habitats after reasonable mixing as shown in the TSS modelling (de Lange, 2024). It therefore is assessed as being consistent with policy 23.

7.3 Summary of Effects

On balance, looking at the Stella Passage Project at the southern Te Awanui scale, I do not consider that the effects of the dredging, reclamation/occupation are more than minor on marine ecological values.

This assessment conclusion is because:

1. The reclamation and occupation are an expansion of a precedent reclamation/occupation in a context already highly modified (Stella Passage).
2. The reclamation and occupation will not affect a natural harbour edge (because it occurs on a coastal edge that has already been modified/reclaimed).
3. The benthic soft sediment and hard shore invertebrates and fish species potentially impacted by the dredging, reclamation and occupation of the CMA are common both in Stella Passage and in the Southern Harbour.
4. There are not predicted to be wide-ranging effects on any species or habitat outside of the dredging, reclamation and occupation footprint.
5. The reclamation and occupation will not affect coastal processes, particularly the movement of water, sediment and organisms through Stella Passage and the southern Te Awanui.
6. The dredging, reclamation and occupation will not have any foreseeable cumulative/synergistic effects with other environmental stressors such as climate change, habitat degradation (e.g., the discharge of sediment and contaminants from land), fish stocks etc and it will not affect species with known decline trends (e.g., pipi on Te Paritaha and seagrass).

The magnitude and level of effects of the proposed dredging activities, reclamation, and areas of permanent occupation on the marine ecological values are outlined in Table 10. The assessments of magnitude of effect are undertaken at the scale of the Stella Passage and the southern Te Awanui.

Table 10: Summary of Marine Ecology Effects of the Proposed Stella Passage Development

Potential Effect	Ecological Value	Magnitude of Effect	Level of Effect without Mitigation	Residual Effect with Mitigation
Coastal Processes Effects from dredging, reclamation and wharf extensions.	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Reclamation (3.58 ha) and Permanent Occupation (0.08 ha) (Including the loss of soft sediment and hard substrate communities. Soft sediment communities will naturally recolonise the sandy benthos. Hard substrate communities will also naturally recolonise new wharf piles).	**High**	**Low and temporary** (1-3 years) **(Stella Passage and southern Te Awanui)** **Very Low** (>3 years) **(Stella Passage and southern Te Awanui)**	**Low** short term **Very Low** longer term The new wharf structures must have similar light and shade and similar hard surfaces (type and area) as the existing wharf structures[97]. Natural restoration of hard shore communities will occur on the new pile structures beneath the wharf	**Nil**

[97] Noting the existing wharf piles are concrete and new wharf piles will be steel tubes – but both materials can be colonised by marine organisms.

Potential Effect	Ecological Value	Magnitude of Effect	Level of Effect without Mitigation	Residual Effect with Mitigation
			extensions. with no long-term loss of biodiversity, so long as the same available habitat is provided on a 1:1 basis.	
Mortality and disturbance of benthic invertebrates within the dredge areas	**High**	**Low** magnitude of effect (1-3 years) immediately with removal of biota and elevated TSS affecting the area **(Stella Passage and southern Te Awanui)**. **Very Low** magnitude of effect (>3 years) longer term with natural recolonisation and restoration of dredged areas (within three years) **(Stella Passage and southern Te Awanui)**.	**Low** short term **Very Low** longer term	**Nil**

Potential Effect	Ecological Value	Magnitude of Effect	Level of Effect without Mitigation	Residual Effect with Mitigation
Extension of harbour edge (which is already modified) further into the harbour	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Effects of shading on biota beneath the new wharf extensions (24,853m^2).	**High**	**Low (Stella Passage and southern Te Awanui)** Invertebrates, macroalgae and fish that are adapted to reduced light will colonise the new piles and habitat beneath the wharfs over time (as has occurred previously).	**Low**	**Nil**
TSS effects on benthic invertebrates (including pipi on Te Paritaha and cockles adjacent to Whareroa Marae), fish, macroalgae and seagrass from dredge activity.	**High**	**Low** and temporary **(Stella Passage and southern Te Awanui)**	**Low**	**Nil**

Potential Effect	Ecological Value	Magnitude of Effect	Level of Effect without Mitigation	Residual Effect with Mitigation
Contaminant availability in sediment within the dredge locations.	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Deposited sediment from dredging TSS	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Effects on water quality and sediment quality	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Effects of marine vessels that are involved in dredging (or other construction) on the risk of invasive species (at the Southern Te Awanui scale).	**High**	**Negligible (Stella Passage and southern Te Awanui)**	**Very Low**	**Nil**
Effects of noise during piling for wharf extensions on marine organisms, including great white shark and green turtle (excluding marine mammals).	**High**	**Low (Stella Passage and southern Te Awanui)** Effects on benthic invertebrates and fish will be of temporary and of short duration. Effects	**Low - Negligible**	**Nil**

Potential Effect	Ecological Value	Magnitude of Effect	Level of Effect without Mitigation	Residual Effect with Mitigation
		on great white shark are temporary and low. Effects on green turtle are considered to be temporary and negligible. Mitigation measures will be established e.g. soft starts to piling and installation of a bubble curtain around piling.		
Cumulative effects Including additional activities that impact on the cumulative ecological values - reclamation (3.58ha), permanent occupation (0.08ha), dredging (10.55ha) shading of pelagic environment by wharf extensions (24,853m^{2}and shoreline modification of an already modified shore.	**High**	**Low (Stella Passage and southern Te Awanui)**	**Low**	**Nil**

8.0 Iwi/Hapū recommendations raised in Cultural Values Assessments (CVA)

Table 11 presents the marine ecology effects identified by iwi/hapū in their CVAs, the recommendations, expert marine ecology response, mitigation proposed by iwi/hapū and the mitigation offered as part of the Project.

Table 11: Marine ecology effects and recommendations proposed by iwi/hapū and mitigation proposed/offered.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
a) Direct loss of taonga species within the area to be dredged. b) Impacts to taonga species' ability to find habitat and prey and avoid predators as a result of increased turbidity due to dredging and construction. c) Increase frequency and	Ngāti Ranginui is resourced to create and implement a Taonga Restoration Plan.	a) and b) Mauao, Moturiki and Motuotau reefs are within the Tauranga Moana Mātaitai Reserve. Semi-annual monitoring of marine taonga species (pāua, kina, kōura and kūtai) in rocky reef habitats within the Tauranga Moana Mātaitai Reserve is undertaken as part of a collaboration between Port of Tauranga and the Tauranga Moana Iwi Customary Fisheries Trust (TMICFT) (Paul-Burke & Burke, 2015, Fairlie et al.,	Create and implement a Taonga Restoration Plan.	Port of Tauranga is already committed to annual monitoring of taonga species in the Tauranga Moana Mātaitai Reserve. Te Paritaha ongoing monitoring offered as a condition of consent. Turbidity generated by the dredging plume and reclamation works will be managed by the measures specified in the draft conditions of consent proffered by POTL, including a Dredge

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
size of ships accessing Te Awanui has the potential to bring pest species that can impact taonga species. d) Fish migration altered by changes in water velocity from dredging		2017, Boffa Miskell Ltd, 2023b, 2024a). Restoration of the taonga rocky shore species that are monitored could be best achieved by a complete long-term period of no take of these species by all fishers, It is understood that Kia Maia Ellis (in her role in the Tauranga Moana Iwi Customary Fisheries Trust (TMICFT)) is working on this possibility currently. c) The increase in frequency of ships to the Port is low - estimated at one ship per day. d) de Lang (2025) concludes the hydrodynamic changes due to the project are not significant (section 6, pg		Management Plan. These controls have been used successfully in previous dredging operations.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
		38). Therefore, effects on fish migration due to water velocity changes are also expected to be insignificant. See Appendix 3 of this report.		
Dredging destroys seafloor, altering species abundance and diversity.	Monitor and report on benthic species recovery, including diversity to understand risks to diversity from changing sea floor.	The benthic community has been monitored previously at the disposal sites. Blom et al. (1993) surveyed the soft sediment dredging disposal area and control sites (to the south east of the disposal site) for benthic marine invertebrate community pre-dredging (1991) and post-dredging (1992). The results indicated high variability between and within stations, thought to reflect the natural variability of the heterogeneous clumped communities, resulting in site specific differences. Blom et al. (1993) found that the control site and a	Monitor and report on benthic species recovery, including diversity to better understand risks to diversity from changing sea floor.	There is scope for this soft sediment monitoring to be conducted under the auspices of the Mātauranga Monitoring Plan described in the consent conditions proffered by POTL, if SPDAG identify it as a priority from a cultural management perspective.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
		disposal site had similar abundance pre and post dredging for bivalve and polychaete, but amphipods showed significant decline in abundance. In the middle of the disposal area a site showed the greatest community changes pre and post dredging. However, sediments at the disposal site were aerobic enabling recruitment of juvenile bivalves (nine weeks after dredge disposal) between the pre-dredging and post-dredging surveys. Pipi was also present at the disposal site during the post-dredging survey, indicating that pipi had been translocated to the disposal site (in dredge material) and survived. Other than the surveys of Blom et al. (1993) , the soft sediment benthic communities within previously dredged and disposal areas and control		

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
		soft sediment habitat have not been monitored (see 7.1.3 of this report)		
No evaluation of vessel strike risk for migrating tuna.	Provide Ngāti Ranginui access to video and webcam surveillance to monitor impacts on tuna migration.	We know that shortfin tuna are abundant in Tauranga Streams and their populations are not in decline. Longfin tuna are also common in Tauranga Streams, but less abundant than shortfin tuna. Longfin tuna have a conservation status of At Risk Declining (with qualifiers (Conservation Dependent and Data Poor). They are classified as C(2) which is having a total area of occupancy > 10000 ha (100 km2), predicted decline 10–70% and very large population and low to high ongoing or predicted decline. (see 7.1.11 of this report)	None specified in the CVA documents reviewed.	With the natural variability in individual tuna migration in terms of days and times, it would be very difficult to capture tuna migration on video and unlikely to discriminate any effects from the Project.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
Dredging may damage Mauao Reef and alter species diversity.	Install and maintain camera monitoring to track species presence and reef health.	There are no identified adverse effects on reefs around Mauao from the proposed Stella Passage development (see 7.1.1 with respect to TSS). Port of Tauranga already monitor taonga species (abundance and size at replicate sites) in the Tauranga Moana Mātaitai Reserve as part of a collaboration between Port of Tauranga and the Tauranga Moana Iwi Customary Fisheries Trust (TMICFT). Port of Tauranga also monitor reef health at Motuatau every two years and relocated boulders in Pilot Bay every 3-5 years. (see Appendix 3 of this report)	Install and maintain camera monitoring to track species presence and reef health.	Not required.
Concerns increased sedimentation and turbidity from dredging can smother benthic organisms and affect	None specified	None specified	None specified	The proposed Dredging Management Plan and Te Paritaha ongoing Monitoring is offered as conditions of consent,

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
water clarity, making it harder for kai moana to thrive.				along with conditions requiring the dredging programme to be modified or to cease if trigger levels of turbidity are met.
Increased risk of biosecurity from larger vessels more frequently visiting the harbour.	None specified	All vessels entering New Zealand waters from overseas are required by national and international regulations to manage the risk of introducing non-indigenous species of concern (NIS) via hull fouling, through MPI's *Craft Risk Management Standard for Vessel Biofouling*, and via ballast water, via the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*. If implemented correctly by incoming vessels, the combined requirements minimise the risk of introducing NIS from vessels.	None specified	Funding of a Bay of Plenty biosecurity programme offered as a condition of consent.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
Reclamation at Sulphur Point will physically cover part of the coastal margin, eliminating whatever intertidal habitat exists there.	Port and hapū can partner in restoration projects elsewhere in Tauranga Moana.	It is my opinion that the Port is already doing a great deal of marine monitoring. The data of which can be used to develop restoration projects as identified by the SPDAG and Whareroa Marae, such as providing resourcing support to the proposed rahui within the Tauranga Moana Mātaitai Reserve.	None specified	Various funds offered as conditions of consent to be administered by SPDAG and Whareroa Marae as appropriate in support of restoration activities.
Concerned about the ongoing incremental loss of ecological values due to reclamation, annual dredging, and the permanent occupation of the seabed by the Port infrastructure.	Pātaka kai and taonga species are included as tohu / environmental indicators in a mātauranga monitoring programme for Te Tāhuna o Rangataua.	The Stella Passage project does not have any significant adverse effects on Te Tāhuna o Rangataua. The main stressors to Te Tāhuna o Rangataua are likely to be sediment runoff and stormwater discharges from the land which is not related to the Port activities. These comments are made without wishing to degrade Mana Tangata, monitoring and any restoration of Te Tāhuna o Rangataua is beyond the Port's influence.	None specified	Mātauranga Monitoring Plan offered as a condition of consent, to include cultural indicators to be surveyed and monitored, as facilitated by SPDAG.

Effect Identified in CVA	Iwi/hapū Recommendation	Marine Ecology Comment	Mitigation Proposed	Mitigation Offered
Concerns effects will reach Rangataua and estuarine systems that host taonga species like tuna and pipi.	Require cultural monitoring and adherence to Waitaha tikanga.	The Stella Passage project does not have any significant adverse effects on Te Tāhuna o Rangataua. The main stressors to Te Tāhuna o Rangataua are likely to be sediment runoff and stormwater discharges from the land which is not related to the Port's activities. These comments are made without wishing to degrade Mana Tangata, monitoring and any restoration of Te Tāhuna o Rangataua is beyond the Port's influence and the scope of this application.	None specified	The proposed consent conditions require that TSHD dredging must be undertaken with a green valve and must not be undertaken with overflow on a flood tide. Conditions also require the consent holder to ensure cultural monitors are present on the dredge to observe the plume when capital dredging is undertaken. Other conditions require turbidity monitoring and the modification or cessation of dredging if trigger levels of turbidity are met. Both sets of draft consent conditions provide for the SPDAG to facilitate the preparation of a Mātauranga Monitoring Plan.

In conclusion, in response to marine ecology effects raised by iwi/hapū, I agree with the Port supporting SPDAG to prepare a Mātauranga Monitoring Plan. Through this process iwi/hapū can determine cultural/environmental monitoring that best represents their cultural values/concerns.

9.0 Avoidance, remediation and mitigation measures

9.1 Avoidance

9.1.1 Turbidity Management

For Stage 1 and 2, the same dredging turbidity limits as the 2015 capital dredging are proposed.

Turbidity generated by dredging will not be greater than 15 NTU above the natural background turbidity levels (consistent with conditions 10.2i and 14.2 of the draft conditions for resource consent RM021-0341).

If three consecutive measurements are collected and found to not comply, then monitoring may be suspended for 14 days.

The proposed limits are useful for monitoring compliance. To provide additional operational guidance the following trigger limits, environmental limits and response framework will be used throughout the duration of the dredging campaign.

Table 12: Proposed Turbidity Trigger Levels

<table>
<tr><th>Port/location</th><th>Trigger 1 (NTU)</th><th>Trigger 2 (NTU)</th><th>Environmental limit (NTU)</th><th>Term/Notes</th></tr>
<tr><td>Pilot Bay</td><td>15</td><td>20</td><td>35</td><td>6 hr Moving Average.</td></tr>
<tr><td>No. 10</td><td>12</td><td>17</td><td>25</td><td>2 Week Moving Average.</td></tr>
<tr><td>Butters</td><td>12</td><td>17</td><td>25</td><td>2 Week Moving Average.</td></tr>
<tr><td>Otūmoetai</td><td>15</td><td>20</td><td>35</td><td>6 hr Moving Average.</td></tr>
<tr><th colspan="5">Response framework</th></tr>
<tr><td>Trigger 1</td><td colspan="4">Investigation into the elevated turbidity. Assess impact of on-going operational dredge.</td></tr>
<tr><td>Trigger 2</td><td colspan="4">Modification to methodology of operational dredging. Including, but not limited to;
• relocation of dredge
• changing dredging equipment
• operate dredge during certain tides times
• modify frequency of dredging operation
• a combination of methods</td></tr>
<tr><td>Environmental limit</td><td colspan="4">Upon reaching the environmental limit dredge operation should cease.</td></tr>
</table>

These water quality trigger limits (Table 12) are the same as those used as the basis for the assessment of affects in Leonard et al. (2020) in which effects due to turbidity were expected to be minimal and short lived. On a marine ecology basis, I support the adoption of these limits as appropriate measures to management sedimentation and TSS impacts of dredging.

9.2 Mitigation

The loss of hard shore habitat beneath the existing wharves (which currently supports a diverse community of invertebrates and fish (and other organisms)) will be covered/shaded by the new wharf extensions, whereby the new wharf piles adjacent to the open harbour will be naturally colonised by a similar suite of sessile organisms as that to be covered/shaded.

It is important to ensure that the new wharf extension designs allow for the same type and area of shade/light environment, the type of structural material and the area of pile (all supplied on a 1:1 basis (existing and new)). The natural recovery of the biodiversity beneath the existing wharves that is being covered/shaded is expected to colonise the new wharf extensions on the open harbour edge within c. 3 years (Valiela, 1995).

10.0 Conclusions

The assessment of effects on marine ecological values has included scientific journal articles, other existing information, reports and evidence prepared for the initial Stella Passage application and Environment Court hearing, in addition to a range of reports prepared by Boffa Miskell Ltd for the POTL.

The range of potential effects from the proposed Stella Passage Development on marine ecological values, considered at both the Stella Passage and Southern Harbour scales, include:

- Effects on coastal processes.
- Increased concentration of TSS (including assessment of resuspended sediment) during dredging, reclamation and installation of permanent structures.
- Permanent loss of benthic CMA due to reclamation and permanent occupation.
- The mortality and disturbance of benthic invertebrates within the areas of reclamation, permanent occupation, and dredging.
- The shading of the pelagic CMA by wharf structures.
- Underwater noise and vibration during piling activities and dredging operations.
- Cumulative effects.

Overall, the effects on marine ecological values from the proposed development will result in **low** or **very low** levels of effect.

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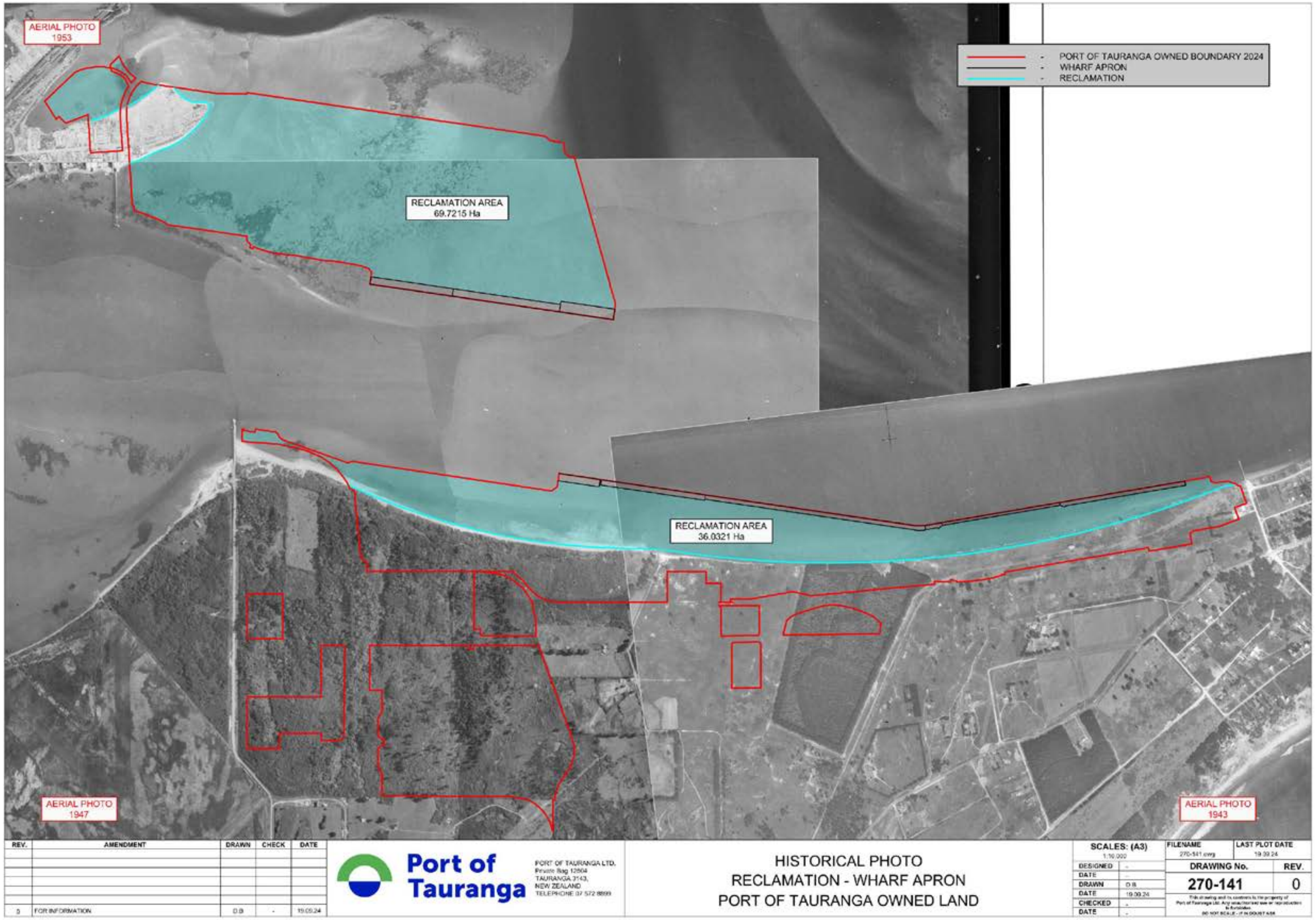
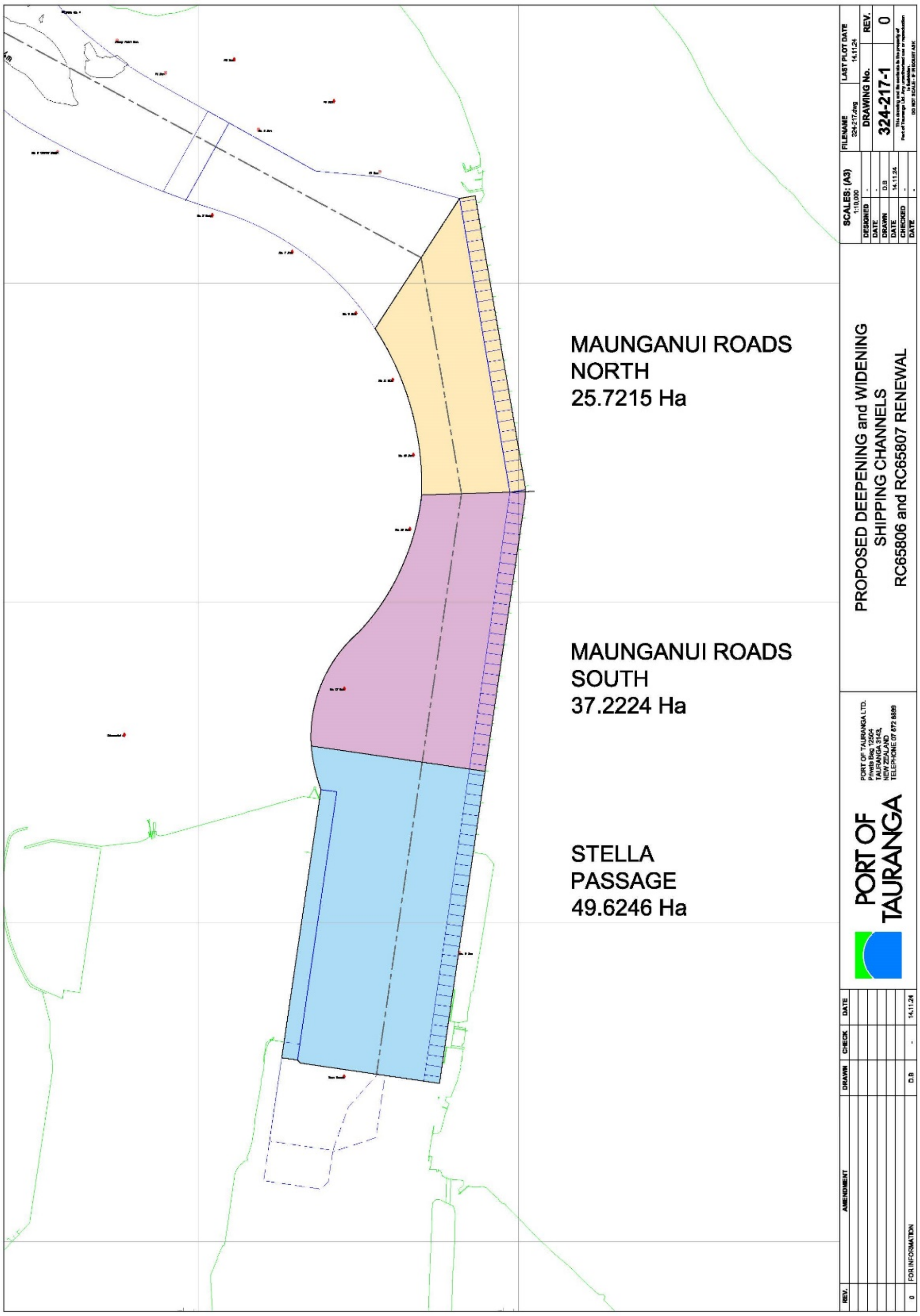
Appendix 1: 1953 aerial with existing reclamation and wharf apron overlaid



Appendix 2: Map of Stella Passage and Maunganui Roads wharves/channel



Appendix 3: Rocky Shores/Reefs of Mauou, Moturiki and Motuotau

The rocky shores of Mauao, Moturiki and Motuotau (**Figure *5***) are wave-exposed, and support kaimoana such as pāua, kina, kōura and kūtai (green lipped mussel) (Boffa Miskell Ltd, 2023a) and typical rocky shore species found on northeastern New Zealand shores.

The shallow parts of Mauau, Moturiki and Motuotau reefs are dominated by kina (*Evechinus chloroticus*), which graze on marine algae. Kōura (*Jasus edwarsii*) and kūtai (*Perna canaliculus*) are also present. Where the reefs are deeper than approximately 15m, sponges, sea squirts (ascidians), bryozoans, anemones and red seaweeds are common (Grace, 2010).

Mauao, Moturiki and Motuotau reefs are within the Tauranga Moana Mātaitai Reserve. Semi-annual monitoring of marine taonga species in rocky reef habitats within the Tauranga Moana Mātaitai Reserve is undertaken as part of a collaboration between Port of Tauranga and the Tauranga Moana Iwi Customary Fisheries Trust (TMICFT) ((Paul-Burke & Burke, 2015, Fairlie et al., 2017, Boffa Miskell Ltd, 2023b, 2024a).

Mauao, Motuotau and Moturiki rocky reef subtidal habitats have been surveyed for presence of taonga species (Boffa Miskell Ltd, 2023a, 2024c) and Motuotau rocky reef subtidal habitat has been surveyed for ecological values (most recently Boffa Miskell, 2024b (in prep); Boffa Miskell Ltd, 2023c).

In 2013, surveys of marine cultural sites and taonga of significance were carried out based on intergenerational mātauranga Māori which included traditional distribution, abundance and sizing of taonga species (Paul-Burke et al., 2013).

In 2015, the Kaimoana Restoration Programme was introduced and is fundamentally informed by mātauranga Māori. Semi-structured interviews with participating iwi representatives were carried out and informed western science marine field surveying techniques (Paul-Burke & Burke, 2015). A modified monitoring programme was carried out in 2016 ((Fairlie et al., 2017) and (Fairlie et al., 2017)). However, the 2016 raw data was not made available to BML or POTL.

The 2023 and 2024 monitoring follows 2013 and 2015 sampling techniques. Site selection is followed where possible, however, site names have varied across years.

The 2023 and 2024 monitoring of the Tauranga Moana Mātaitai Reserve focused on assessing the abundance, size, and contamination levels of key customary taonga species including kina, kūtai, pāua, and kōura. This is part of the long-term Kaimoana Restoration Programme, initiated in 2015 to ensure sustainable management of these species, especially with ongoing port developments. Key species were monitored across sites of cultural significance including Mauao, Moturiki, Motuotau, and Tanea Reef using various methods such as quadrat sampling and timed counts (Boffa Miskell Ltd, 2024b).

Body burden of contaminants (heavy metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated bi-phenols (PCBs)) was carried out in kaimoana species (either in total flesh or various organs (e.g. gut, foot, tail) in 2024.

ESR (2024) were asked to comment on the potential public health significance of the levels of contaminants found. ESR concluded concentrations of metals/metalloids and PAHs found in edible biota from Tauranga Harbour are generally within the normal range for these substances, as determined from other studies. The findings are summarised below.

Arsenic

Arsenic concentrations in all biota types are high, with the highest levels in crayfish tails. High arsenic concentrations are not unexpected in Te Awanui as it lies within the Taupo Volcanic Zone (TVZ). Despite the high levels of arsenic in crayfish edible tissues, toxic inorganic arsenic likely accounts for approximately 0.2% of the total arsenic.

Cadmium

Cadmium concentrations are generally low (<0.2 mg/kg), except for gut samples from pāua and crayfish. It is likely that the TVZ will have contributed to the cadmium content of biota.

Chromium

Chromium concentrations were below the analytical limit of detection in most samples.

Copper

The New Zealand Food Composition database states copper content of pāua, raw as 10 mg/kg.[98] Only the pāua gut sample from Moturiki was higher than 10 mg/kg and copper concentrations appear to be within the normal range for this species. Copper concentrations were elevated in crayfish gut, compared to all other tissues. ESR consider it is likely that this concentration is normal.

Lead

Lead concentrations were low (<0.1 mg/kg) in all samples, except for pāua gut samples (0.13 and 0.32 mg/kg).

Mercury

All mercury concentrations are less to 0.1 mg/kg.

Nickel

Concentrations of nickel were higher in pāua and in crayfish gut, compared to other tissues.

Zinc

Zinc concentrations in pāua and crayfish gut were slightly elevated in the Tauranga samples.

Polycyclic aromatic hydrocarbons (PAH)

Very low concentrations of PAHs (and typically below laboratory detection limits) were detected[99].

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[98] https://www.foodcomposition.co.nz/search/food/T10/full-alphabetical Accessed 30 September 2024

[99] none of the PAHs detected were of greatest toxicological concern (i.e. benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene and chrysene)

With respect to dietary exposure, ESR state that in order to assess the potential impact on human health of the contaminants detected in marine biota from Tauranga Harbour and the environs, dietary exposure estimates for arsenic, cadmium, lead and zinc were assessed.

Inclusion of these biota in a typical New Zealand diet would have a negligible impact on dietary exposure to the selected contaminants. While some consumers may consume these foods in greater amounts or at a greater frequency, recalculating dietary exposure estimates with a 10-fold higher inclusion of these marine biota (60 g/day) increased estimates of dietary exposure by no more than 1%.

Trace metal contamination were within safe human consumption levels for the pāua foot, although elevated zinc levels were found in the pāua gut at Mauao. Arsenic levels in kōura gut exceeded human health safety guidelines at both Mauao and Motuotau. Other contaminants, such as cadmium and mercury, were within safe limits.

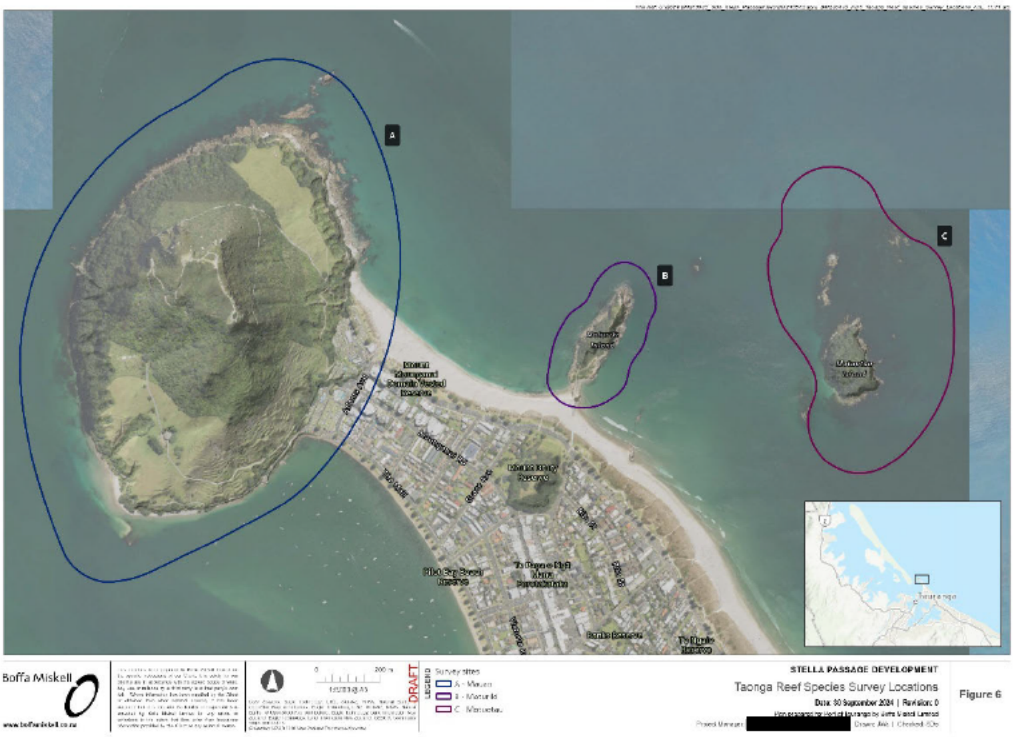

Figure 5: Taonga Reef Species Survey Locations

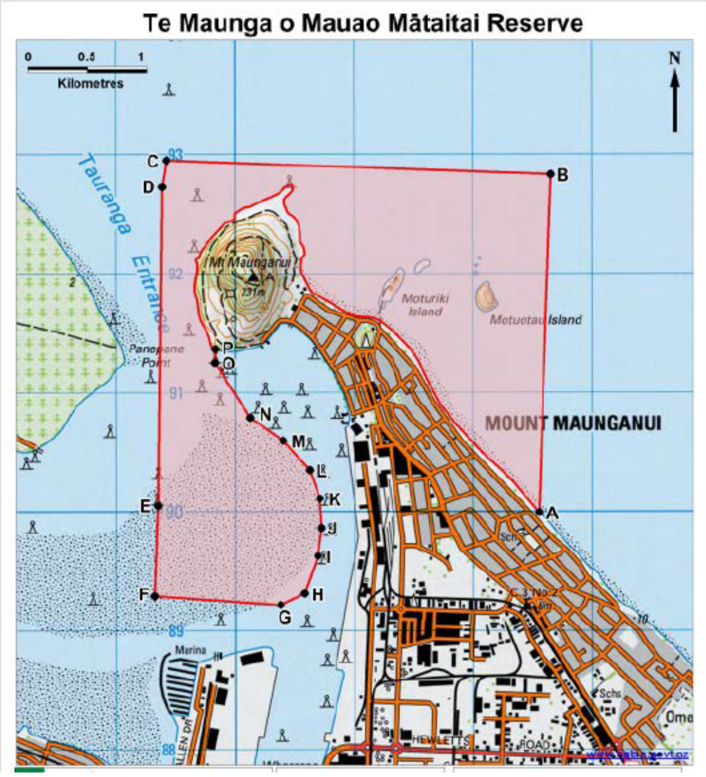

Figure 6: The location of the Te Maunga o Mauao Mātaitai Reserve

Kina, pāua, kōura and kūtai were the main taonga species surveyed based on a mātauranga Māori approach[100].

Table 13: Tauranga Moana Mātaitai Reserve Surveys 2013-2023.

Baseline (2013) (Paul-Burke et al., 2013)	**Year 1 (2015)** (Paul-Burke & Burke, 2015)	**Year 2 (2016)** (Fairlie et al., 2017)	**Year 3 (2023)** (BML, 2023b)	**Year 4 (2024)** (BML, 2024c)
Kina	Kina	Kina	Kina	Kina
Kūtai	Kūtai	Kūtai	Kūtai	Kūtai
Pāua	Pāua	Pāua	Pāua	Pāua
Kōura not surveyed	Kōura	Kōura not surveyed	Kōura	Kōura

Average kina abundances within the Tauranga Moana Mātaitai Reserve in 2023 were higher than in the baseline year (2013) but lower than in 2015 (Paul-Burke & Burke, 2015). The 2023 survey showed that the highest abundance of kina was found at Mauao, with an average of 0.63 kina per 1m^2 quadrat, while there was and an average of 0.42 kina per 1m^2 quadrat at Motuotau

[100] Baseline surveys, and therefore the entirety of the Kaimoana Restoration Programme is fundamentally informed by mātauranga Māori whereby semi structured interviews with Tauranga Moana, participating iwi representatives including kaumātua were carried out in 2013 to identify cultural sites of significance in the Tauranga Moana Mātaitai Reserve. Intergenerational mātauranga Māori identified traditional distribution, abundance and sizing of taonga species; kina, kūtai, kōura, pāua and pūpū across all identified sites.

(Boffa Miskell Ltd, 2023a). Kina abundance in 2024 showed a non-significant drecrease compared to 2023 abundance at all sites (Boffa Miskell, 2024c). Comparison of previous kūtai (mussels) abundances between 2013, 2015 and 2023 was made difficult due to different surveying methods being used among surveys periods. Surveys conducted during 2023 revealed high variability in the average of kūtai (between 22 and 111 individuals per $0.25m^2$ quadrat) (Boffa Miskell Ltd, 2023a). Previous surveys in 2013, and 2015 and 2016 used quite different survey methods and different sites names compared to the 2023 survey resulting in the data is not statistically comparable. Percentage cover of kūtai, the increased in 2024 at all sites compared to earlier years (Boffa Miskell, 2024c).

Average pāua abundance per 10-minute timed survey varies across years with an average of 25 for 2023, 20-30 for 2016, 114 for 2015 and 35 for 2013. This indicates a decrease in average pāua abundance for 2023 in comparison to previous years. Pāua abundance showed a decline in abundance in 2024 compared with 2023 data (Boffa Miskell, 2024c).

Kōura was first introduced into the Tauranga Moana Mātaitai Reserve surveys in 2015, with an average abundance of 1.3 kōura per 10-minute timed survey (n = 13). Sampling effort increased in 2023 (n = 165), however, the average abundance of kōura decreased to 0.4 per timed survey (Boffa Miskell Ltd, 2023a). Kōura abundance in 2024 remained generally low but showed a slight increase compared to 2023 abundance at some sites (Boffa Miskell, 2024c).

In summary, kina abundance in 2024 showed a non-significant decrease compared to 2023 abundance at all sites. For kūtai, the percentage cover across survey sites increased in 2024 compared to earlier years. Pāua abundance showed a decline in abundance in 2024 compared with 2023 data. Kōura abundance in 2024 remained generally low but showed a slight increase compared to 2023 abundance at some sites.

Motuotau Reef has been monitored every few years between 1990 and 2022. The most recent monitoring (November 2022) indicated the reef supported a healthy assemblage of marine organisms that is comparable to other reefs of similar depth, aspect, and exposure along the Bay of Plenty coastline (Boffa Miskell Ltd, 2023b). As in previous surveys, the benthic communities in 2022 were characterised by the presence of large canopy-forming macroalgae along with a diverse understory including sponges, hydroids, mussels, anemones and a wide range of red algae (Boffa Miskell Ltd, 2023b). Many of these reef taxa are known to be highly sensitive to sedimentation. The 2022 surveys at Motuotau Reef did not show any change in the structure and diversity of these communities which could be connected to the Port of Tauranga's dredging program, in comparison to previous years surveys (Boffa Miskell Ltd, 2023b).

Appendix 4: Te Paritaha Surveys

In the areas sampled both in 2022 and 2023 (Grid 1 and Transects A, B, C) there was a significant increase in the abundance of recruit and juvenile pipi, which is indicative of large recruitment events occurred between the two sampling events. There were high abundances of recruits and juveniles also in subtidal areas sampled for the first time in 2023, at Grid 2 and Grid 3 (Boffa Miskell Ltd, 2023c, 2024a).

By expanding the surveys to new subtidal areas in 2023, surveys were able to better capture the patchy distribution of large subtidal pipi around Te Paritaha. Grid 3 was the subtidal area with the highest abundance of adults, with an estimated density of 528 individuals > 40 mm per m^2, compared to 51 adults per m^2 at Grid 2 and 186 adults per m^2 in the area encompassed by Transect A, B, C and D.

Comparisons with the results of previous surveys of Te Paritaha by Fairlie et al. (2017) and Ross & Culliford (2018) show a large decline in the abundance of adult pipis between 2016 and 2022, with no sign of recovery in adult pipi in 2023. The studies of Fairlie et al. (2017) and Ross & Culliford (2018) showed that the abundance of large pipi in the early aftermath of the 2015 capital dredging (i.e., in 2016 and 2017) was in line with pre-dredging levels. However large declines must have occurred in the period 2016/2017–2022, causing a shift to a population structure dominated by recruits and juveniles.

Similar patterns of natural declining abundances of large individuals have been observed in intertidal populations of both pipi and cockles across the upper North Island (Berkenbusch et al., 2022; Berkenbusch & Hill-Moana, 2023). The reasons for the general decline of large individuals within northern pipi and cockle populations remain unknown, but are likely to include harvesting pressure, changes in the benthic environment (e.g., grain size and topography of the seabed), adverse weather conditions (particularly unusually hot weather), poor water quality, parasites and bacteria (Berkenbusch et al., 2022; Berkenbusch & Hill-Moana, 2023).

The 2023 pipi survey results do not show significant changes in the physical structure of the benthic environment at Te Paritaha. The soft sediment habitat in 2023 was relatively uniform across the study area, with medium and coarse sand being the dominant grain size fractions. Coarse and medium sand were the dominant grain size fractions also in 2016 (Fairlie et al. 2017), suggesting that there were not large changes in the physical structure of the intertidal benthic habitat coinciding with the decline of adult pipi between 2016 and 2022.

Pollutants in the seabed and in the water column are unlikely to be the main driver of the decline of large pipi at Te Paritaha, as the 2023 surveys found low levels of contaminants both within the sediment and within the pipi as body burden.

While large pipi remained virtually absent in the intertidal area of Te Paritaha in 2023, the high recruitment rates observed across the study area in 2023 suggest that healthy aggregations of reproductive individuals are present within Te Awanui.

The November 2024 data (also in March and May 2024) showed a decline in the abundance of intertidal pipi relative to the very high numbers of November 2023. The November 2024 data showed a trend of increasing shell length in the cohort of juveniles which dominated the population (at Grid 1).

The November 2024 subtidal pipi data showed a trend of increased shell length in the juvenile cohort and also a higher abundance of adult pipi in comparison to all previous sampling events in 2023 and 2024.

Species such as pipi are well known for their natural spatial and temporal abundance and size class variability (Hooker, 1995). Repeating the surveys of pipi according to the revised Te Paritaha Monitoring Plan will be key to assessing whether the large wave of recruitment detected in 2023 can translate into increasing abundances of larger individuals at Te Paritaha.

In 2024 sediment, pipi and other kaimoana on Te Paritaha were surveyed on three occasions, March, May and November 2024 (Boffa Miskell Ltd 2024b, 2024c, 2024d). The same survey methodology as that in 2023 were carried out in the three 2024 surveys (March, May and November), with the addition of green lipped mussel surveys (c. 300m distance from the boundaries of Grids 2 and 3) (Boffa Miskell Ltd, 2024b, 2024c) on Te Paritaha in March and May 2024 (mussel being the only other kaimoana species detected on Te Paritaha) (Boffa Miskell Ltd, 2024b, 2024c). Mussel bed density, area, and shellfish size formed the surveys.

Results from the March, May and November 2024 surveys showed similar sediment contaminant and pipi body burden contaminants compared data collected in 2023 (Boffa Miskell Ltd, 2024b, 2024c, 2024d).

Survey of pipi abundance and distribution, pipi contaminant body burden and sediment chemistry and grain size and measures of mussel beds will undertaken bi-annually annually in the future.

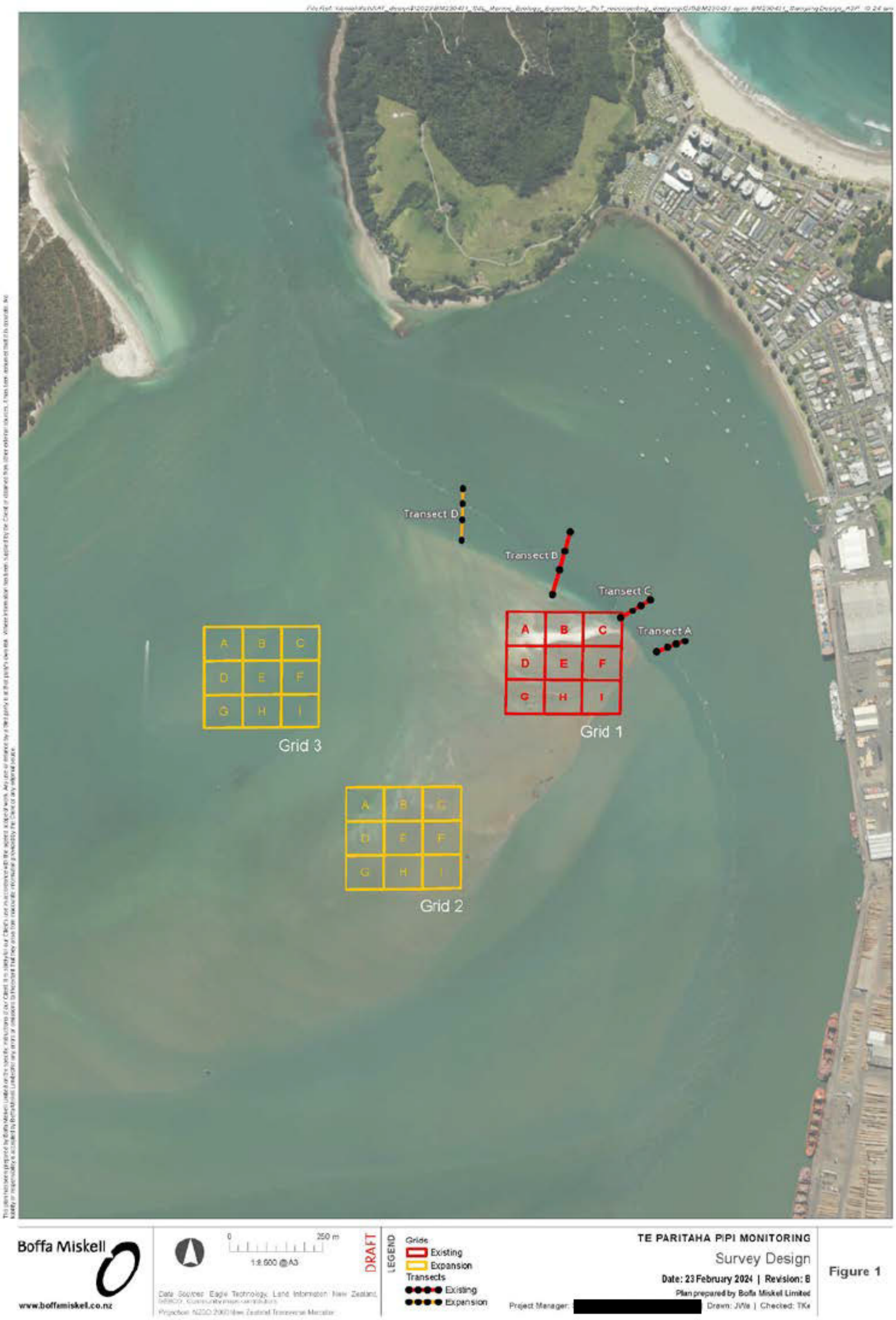

Figure 7: Te Paritaha pipi sampling grids and transects

Figure 8: BML Pipi and Mussel Sampling Design 2024

11.1.1 Sediment Chemistry Data 2023 and 2024

Surface sediment (top 2-3 cm) was collected at the four transects and three grids in 2023 and 2024 ((Boffa Miskell Ltd, 2024a, 2024b, 2024c)). Sediment was analysed for heavy metals, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB) and tri-butyl tin (TBT). The results indicate low concentrations of all contaminants (some heavy metals were above laboratory detection limits), with PAHs, PCBs, and TBT below laboratory detection limits[101] (Table 14 to **Table *17***).

Table 14: Concentration of heavy metals in surface sediment 2023 (see also Figure 7)

Contaminant (mg/kg dw)	Transect A	Transect B	Transect C	Transect D	Grid 1	Grid 2	Grid 3	ANZG DGV
Arsenic	6.0	5.5	5.7	8.0	6.3	5.8	6.6	20
Cadmium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	1.5
Chromium	3.5	2.0	2.1	1.9	2.3	2.3	2.0	80
Copper	0.4	0.2	0.2	0.2	0.23	0.17	0.2	65
Lead	1.62	1.06	1.14	1.17	1.19	1.16	1.1	50
Mercury	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15
Nickel	0.9	0.6	0.7	0.6	0.6	0.6	0.7	21
Zinc	9.0	6.3	7.1	6.9	7.0	7.13	6.7	200
Total PAHs	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	10
Total PCBs	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.034
Tributyltin	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.009

Table 15: Average concentration of heavy metals in surface sediment March 2024 (see also Figure 7)

Contaminant (mg/kg dw)	Transect A	Transect B	Transect C	Transect D	Grid 1	Grid 2	Grid 3	ANZG DGV
Arsenic	5.3	5.5	5.5	7.8	5.8	5.7	6.8	20
Cadmium	0.005	0.005	0.011	0.005	0.005	0.005	0.005	1.5
Chromium	3.9	2.3	2.5	2.3	2.2	2.5	2.5	80
Copper	0.3	0.3	0.3	0.3	0.27	0.2	0.33	65
Lead	1.77	1.22	1.45	1.26	1.0	1.22	1.36	50
Mercury	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15
Nickel	0.9	0.7	0.7	0.9	0.8	0.63	0.73	21
Zinc	9.4	7.8	7.6	7.7	6.8	6.87	8.0	200
Total PAHs	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	10

Table 16: Average concentration of heavy metals in surface sediment May 2024 (see also Figure 7)

Contaminant (mg/kg dw)	Transect A	Transect B	Transect C	Transect D	Grid 1	Grid 2 Ave A-I	Grid 3 Ave A-I	ANZG DGV
Arsenic	3.8	7.0	6.4	6.5	6.27	6.4	7.0	20
Cadmium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	1.5
Chromium	3.5	2.4	2.8	2.2	2.6	2.7	2.8	80
Copper	0.4	0.3	0.2	0.2	0.3	2.7	0.27	65
Lead	1.59	1.26	1.38	1.31	1.39	1.3	1.26	50
Mercury	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15
Nickel	0.8	0.8	0.8	0.7	0.87	0.8	0.77	21
Zinc	9.0	8.1	7.8	7.4	8.1	24.4	7.4	200
Total PAHs	0.003	0.003	0.003	0.003	0.05	0.003	0.06	10

[101] Where concentrations were below laboratory detection limits, half the detection is used as the value to be conservative.

Table 17: Average concentration of heavy metals in surface sediment November 2024 (see also Figure 7)

Contaminant (mg/kg dw)	Transect A	Transect B	Transect C	Transect D	Grid 1	Grid 2	Grid 3	ANZG DGV
Arsenic	8.1	5.6	6.8	8.0	5.4	4.7	6.13	20
Cadmium	0.011	0.005	0.005	0.011	0.007	0.001	0.01	1.5
Chromium	3.1	2.0	2.9	2.1	2.5	2.9	2.3	80
Copper	0.4	0.2	0.3	0.4	0.27	0.3	0.27	65
Lead	1.55	1.10	1.47	1.44	1.4	1.36	1.4	50
Mercury	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.15
Nickel	0.9	0.6	0.8	0.8	0.67	0.7	0.7	21
Zinc	8.2	6.3	8.1	7.9	7.0	8.0	7.3	200
Total PAHs	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	10

11.1.2 Pipi Chemistry Data 2023 and 2024

Pipi flesh collected as composite samples in 2023 and 2024 from Grids 1, 2 and 3, and Transects B and D (Figure 8), Pipi flesh was collected (where adults were present[102]) from Grids 1, 2 and 3 and Transects A, B, C, and D in March, May and November 2024 (Table 18 to Table 20).

All contaminants analysed were detected at either very low concentrations or below laboratory detection limits[95]. Some heavy metals were above minimum laboratory detection limits, whereas no organochlorine pesticides, polyaromatic hydrocarbons or polychlorinated biphenyls were detected (Table 18 to Table 20).

Analyses of pipi flesh in 2023 at Te Paritaha for contaminants showed concentrations of arsenic above the maximum level of metal contaminants of the Australia and New Zealand Food Standards Code[103] (Australian Government, 2024) across all grids and transects. However, the ANZFSC refers to inorganic arsenic which is approximately 10% or less of total arsenic. Therefore, the concentration of inorganic arsenic in shellfish is highly likely to be significantly below ANZFSC maximum concentration. Concentrations of cadmium, lead, mercury and polychlorinated biphenyls accumulated within the pipi were below the ANZFSC (Table 18 to Table 20).

Table 18: Concentrations of metals accumulated within the pipi flesh 2023 across all grids and transects (see Figure 8) where it was possible to collect 30 g of pipi flesh and where there is an ANZFSC maximum concentration for human consumption.

Contaminant (mg/kg)	Grid 1 A-B-C	Grid 2 A-B-C	Grid 3 Ave A-I	Transect B	Transect D	ANZFSC Max. conc.
Arsenic (Total)	1.69	2.0	1.94	2.1	2	1 (inorganic)
Cadmium	0.101	0.147	0.20	0.17	0.23	2
Lead	0.01	0.053	0.026	0.02	0.095	2
Mercury	0.005	0.005	0.009	0.011	0.005	1.5
Organochlorine pesticides (all individual)	0.006	0.006	0.006	0.006	0.006	NA

[102] Resulting in some grids and transect samples over the survey periods having to be composited due to lack of adult pipi available, making direct comparisons over time difficult.

[103] https://www.legislation.gov.au/F2015L00454/latest/text

Contaminant (mg/kg)	Grid 1 A-B-C	Grid 2 A-B-C	Grid 3 Ave A-I	Transect B	Transect D	ANZFSC Max. conc.
Polycyclic aromatic hydrocarbons (total)	0.008	0.008	0.008	0.008	0.008	NA
Polychlorinated biphenyls (total)	0.01	0.01	0.01	0.01	0.01	0.5

Analyses of pipi flesh in March, May and November 2024 (**Table *19*** to 20) at Te Paritaha for contaminants indicated pipi exceed the total arsenic maximum level of metal contaminants of the ANZFSC at grids and transects. However, as stated in the paragraph above, the ANZFSC refers to inorganic arsenic which is approximately 10% or less of total arsenic. Therefore, the concentration of inorganic arsenic in shellfish is highly likely to be significantly below ANZFSC maximum concentration of total arsenic. Concentrations of cadmium, lead, mercury and polychlorinated biphenyls accumulated within the pipi were below the ANZFSC in all grid and transect samples.

The likely source of the PAHs above laboratory detection limits in pipi flesh (but still very low concentration) from all grids (excluding grid 1) and transects in May 2024 (Table 19***)*** is a spill of diesel and heavier oil (estimated less than 100L) on 20/05/2024[104].

Table 19: Concentrations of metals accumulated within the pipi flesh March 2024 across all grids and transects (see Figure 8) where it was possible to collect 30 g of pipi flesh and where there is an ANZFSC maximum concentration for human consumption.

Contaminant (mg/kg)	Grid 2 Average A-I	Grid 3 Average A-I	Transect B	Transect C	Transect D	ANZFSC Max. conc.
Arsenic (Total)	1.78	1.82	2.0	2.0	1.99	1 (inorganic)
Cadmium	0.11	0.11	0.138	0.09	0.102	2
Chromium	0.1	0.29	0.5	1.2	0.1	NA
Copper	0.82	0.93	1.03	0.85	0.82	NA
Lead	0.01	0.0095	0.0095	0.02	0.01	2
Mercury	0.005	0.008	0.005	0.005	0.005	1.5
Nickel	1.4	0.22	0.31	0.53	0.11	NA
Zinc	8.6	9.63	11.2	9.5	11.0	NA
Organochlorine pesticides (all individual)	0.006	0.006	0.006	0.006	0.006	NA
Polycyclic aromatic hydrocarbons (total)	0.008	0.008	0.008	0.008	0.008	NA
Polychlorinated biphenyls (total)	0.01	0.01	0.01	0.01	0.01	0.5

104 BOPRC staff undertook oil removal by bagging any noticeably impacted sand along the shoreline at Pilot Bay and conducting on-water recovery. Several potential sources were investigated, but the actual source has not been identified (source Bay of Plenty Times, 20/05/2024).

Table 20: Concentrations of metals accumulated within the pipi flesh May 2024 across all grids and transects (see Figure 8) where it was possible to collect 30 g of pipi flesh and where there is an ANZFSC maximum concentration for human consumption.

Contaminant (mg/kg)	Grid 1 A-B-C	Grid 2 A-B-C	Composite 2 D-F-G	Grid 3 Av A-I	Composite Transect A, C & D	Transect B	ANZFSC Max. conc.
Arsenic (Total)	1.43	2.2	1.87	1.85	1.83	7.0	1.0 (inorganic)
Cadmium	0.066	0.092	0.079	0.11	0.117	0.005	NA
Chromium	0.01	0.32	0.095	0.45	0.01	0.8	NA
Copper	0.68	1.12	0.92	0.81	0.91	0.65	NA
Lead	0.1	0.73	0.022	0.1	0.1	0.1	1
Mercury	0.68	0.009	0.005	0.005	0.005	0.005	1.65
Nickel	0.01	0.17	0.1	0.26	0.11	0.4	NA
Zinc	9.4	9.4	8.6	8.57	9.2	8.3	NA
Organochlorine pesticides (all individual)	0.006	0.006	0.006	0.006	0.006	0.006	NA
Polycyclic aromatic hydrocarbons (all	0.008	0.0214	0.0199	0.0144	0.0142	0.0206	NA
Polychlorinated biphenyls (total)	0.01	0.01	0.01	0.01	0.01	0.01	0.5

Table 21: Concentrations of metals accumulated within the pipi flesh November 2024 across all grids and transects (see Figure 8) where it was possible to collect 30 g of pipi flesh and where there is an ANZFSC maximum concentration for human consumption.

Contaminant (mg/kg)	Grid 1	Grid 2	Grid 3	Transect A	Transect B	Transect C	Transect D	ANZFSC Max. conc.
Arsenic (Total)	2.7	1.51	1.54	1.47	1.54	1.52	1.67	1.0 (inorgani
Cadmium	0.21	0.151	0.182	0.107	0.136	0.130	0.28	NA
Chromium	0.5	0.095	0.1	0.1	0.095	0.1	0.1	NA
Copper	1.4	0.08	0.79	0.73	0.76	0.63	1.00	NA
Lead	0.05	0.0095	0.1	0.1	0.0095	0.01	0.01	1
Mercury	0.025	0.005	0.005	0.005	0.005	0.005	0.005	1.65
Nickel	0.025	0.05	0.09	0.05	0.9	0.05	0.10	NA
Zinc	14	8.7	9.6	9.9	9.9	8.3	11.2	NA
Organochlorine pesticides (all individual)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	NA
Polycyclic aromatic hydrocarbons	0.008	0.008	0.008	0.008	0.008	0.008	0.008	NA
Polychlorinated biphenyls (total)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.5

Appendix 5: Bay of Plenty RPS Appendix F, Set 3. Indigenous vegetation and habitats of indigenous fauna

Representativeness

3.1 Indigenous vegetation or habitat of indigenous fauna contains associations of indigenous species representative, typical or characteristic of the natural diversity of the region or any relevant ecological districts.

Rarity or distinctive features

3.2 Indigenous vegetation or habitat of indigenous fauna supports an indigenous species or associations of indigenous species threatened or rare nationally, regionally or within the relevant ecological district.

3.3 Indigenous vegetation or habitat of indigenous fauna can contribute to the maintenance or recovery of a species threatened or rare nationally, regionally or within the relevant ecological district.

3.4 Indigenous vegetation or habitat of indigenous fauna is distinctive, of restricted occurrence, or at the limits of its natural distribution range, or has developed as a result of factors such as natural geothermal activity, historical cultural practices, altitude, water table, or soil type.

3.5 Indigenous vegetation or habitat of indigenous fauna is one of the largest remaining examples of its type within the region or any relevant ecological district.

3.6 Indigenous vegetation or habitat of indigenous fauna is significantly reduced in area and is degraded but retains key natural ecosystem functions (for example hydrology) and has a high potential for restoration.

Diversity and pattern

3.7 Indigenous vegetation or habitat of indigenous fauna contains a high diversity of indigenous ecosystem or habitat types, or changes in species composition, reflecting the existence of natural features (for example landforms, soil types or hydrology), or communities along an ecological gradient.

Naturalness

3.8 Indigenous vegetation or habitat of indigenous fauna is in a natural state or healthy condition, or is in an original condition.

Ecological context

3.9 Indigenous vegetation or habitat of indigenous fauna contributes to the ecological viability of adjoining natural areas and biological communities, by providing or contributing to an important ecological linkage or network, or providing a buffer from adjacent land uses.

3.10 Indigenous vegetation or habitat of indigenous fauna provides habitat for indigenous species at key stages of their life cycle.

Viability and sustainability

3.11 Indigenous vegetation or habitat of indigenous fauna is of sufficient size and compact shape and has the capacity to maintain its ecological viability over time.

3.12 Indigenous vegetation or habitat of indigenous fauna supports intact habitats and healthy functioning ecosystems.

3.13 Indigenous vegetation or habitat of indigenous fauna is of sufficient size and compact shape to resist changes initiated by external agents.

Māori

3.14 Indigenous vegetation or habitat of indigenous fauna contributes to the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga.

(Refer also to set 4 - Māori Culture and Traditions criteria).

Historical

3.15 Indigenous vegetation or habitat of indigenous fauna is known and valued for its connection to the history of the place.

Community association

3.16 Indigenous vegetation or habitat of indigenous fauna is known and valued by the immediate and wider community for its contribution to a sense of place leading to community association with or public esteem for the place, or due to its value for recreation or education.

3.17 Indigenous vegetation or habitat of indigenous fauna is valued for the contribution it is making to research into the Bay of Plenty’s or New Zealand’s ecosystems.