APPENDIX 13

COASTAL PROCESSES ASSESSMENT

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

New Zealand Government
Te Kāwanatanga o Aotearoa

REPORT

Shipyard and Drydock facility at Marsden Point, Whangarei Harbour Coastal Effects Assessment

Prepared for
Ministry of Business, Innovation & Employment

Prepared by
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Executive summary

MBIE proposes to develop the Northland Shipyard and Dry Dock Project, being a marine operations facility abutting the western side of the existing Northport facility at Marsden Point, Whangārei Harbour (“Northland Dry Dock”, or “NDD”). The NDD project includes a reclamation, vessel haul-out system, and associated wharf structures, dredging, and supporting infrastructure. The facility will be situated between Northport to the east and Blacksmiths Creek estuary and Marsden Bay to the west.

As part of the technical studies being carried out, MBIE commissioned Tonkin + Taylor (T+T) to assess the potential effects of the proposed activities on coastal processes. This assessment supports the Assessment of Environmental Effects. It is part of a suite of technical reports that assess the actual and potential effects of the applications.

Physical coastal setting

Whangārei Harbour is located at the northern end of Bream Bay on the northeast coast of the North Island and is a meso-tidal drowned river valley. The harbour is relatively shallow due to extensive intertidal flats. The harbour is accessed through a relatively narrow tidal inlet which is around 680 m wide and 32 m deep at its deepest point. The inlet is bounded by Tertiary volcanic rocks on the northern side and a Holocene prograde sandy barrier spit on the southern side, which forms Marsden Point. Several bays indent the northern shoreline of the lower harbour, the largest of which is Parua Bay. The inlet channel separates a large ebb tide delta that extends seaward to around the 20 m depth contour. Mair Bank is situated on the northern side of the channel, largely within the intertidal and subaerial portion of the southern ebb tide delta. Snake Bank and McDonald Bank are the two main flood-tidal deltas located within the harbour inlet embayment.

The sediments within the tidal inlet largely comprise medium to fine sands with a reasonable proportion of shell and low levels of silt. Typically, the suspended sediment concentration values are low, with around 6 mg/L within the tidal channel and on Mair Bank and up to 30 mg/L on the intertidal areas of the harbour.

The mean tide range is 2.3 m during spring tide and 1.5 m during neaps. Tidal current velocities gradually decrease up-harbour, from around 1 m/s (≈2 knots) at Marsden Point to 0.8 m/s (≈1.5 knots) at Limestone Island. Tidal streams are strongest in the area adjacent to Home Point southeast of Marsden Point, where rates up to 1.5 m/s (≈ 3 knots) may be experienced. The constricted tidal inlet results in currents reaching peak depth-averaged velocities of 1.1-1.3 m/s (≈2.1 to 2.3 knots) during spring tides.

The Whangārei Harbour inlet entrance emerges in a zone of low energy that provides natural stability to the inlet. Wave activity inside the harbour is mostly locally generated (north westerly fetch ~5km near Marsden Point).

Coastal processes

The Whangārei Harbour entrance and the lower harbour area is dynamically stable, controlled by Whangārei Heads to the north and the large ebb delta to the south. The northward directed net longshore sediment transport on the open coast of Bream Bay is very small in comparison with the sediment flux that enters and exits the harbour because of tidal exchange. Therefore, the inlet is tide dominated, with tidal flows significantly greater than the net littoral transport which results in a stable inlet.

Sediment transport trends in Marsden Bay are low due to the low wave energy environment, dominated by infrequent higher energy wind generated waves at high tide from the dominant NW fetch and to a lesser degree discharges from the Creek and flood tide flows.

Ongoing and accelerated sea level rise may result in increased wave heights acting within Marsden Bay due to the greater water depth, which is likely to result in erosion of the upper beach systems, with sediment transported to the intertidal shelf and then transported towards the east due to the dominant wind wave direction along the main harbour channel to the northwest.

Proposed development

The development and operation of a marine maintenance operations facility abutting the western side of the existing Northport port facility at Marsden Point, Whangārei Harbour. The project includes a 9.7 ha reclamation, vessel haul-out system, and associated wharf structures, dredging, and supporting infrastructure.

The marine maintenance operations facility is to provide vessel maintenance, repairs, and servicing, including but not limited to cleaning, painting, and repair of commercial and naval vessels, including Cook Strait ferries and Royal New Zealand Navy logistics vessels, along with other vessels such as international freight vessels and super yachts. The facility has design capacity to accommodate vessels ~50m to 230m in length with displacement between 500 t and 28,000 t. The facility will be based on normal working hours of 7am-6pm but the capacity to operate 24/7/365 where required, subject to appropriate restrictions on noise-generating activities.

Capital and maintenance dredging associated with construction and ongoing operation of the marine maintenance operations facility, including a berth pocket and a vessel turning basin to provide for safe navigation. Stage 1 dredging involves dredging of the swing basin area and the berth pocket (total volume around 753,209 m^3). An additional 710,600 m^3 is then proposed to be dredged within the dredge footprint area to ensure sufficient fill is available for both the marine maintenance operations facility and Northport's consented expansion project.

We have assumed dredging will be carried out by either a Trailing Suction Hopper Dredge (TSHD) or a Cutter Suction Dredge (CSD), with a Backhoe Dredge (BHD) required in the more confined areas.

Maintenance dredging is to be expected to be necessary, particularly within the first few years following capital dredging as side slopes settle, mainly along the western side slopes of the dredged cut and within the berth pocket.

A circular sand bank / bird roost with similar footprint and elevation to that consented by Northport as mitigation for the occupation of the beach to the east of the existing port reclamation is proposed. The proposed sand bank / bird roost will have a crest level of around 1.6 m RL, or around 0.6 m higher than MHWS. This will ensure that the surface is not frequently inundated by waves at high tides.

Due to the roost being formed from dredged sand, top-ups of the roost may be required to maintain a reasonable high tide area. Therefore, there will need to be monitoring, and a top-up plan established as part of the management of this roost. It is anticipated that this monitoring and management be undertaken as part of the Northport suite of resource consents.

Summary of the effects assessment

Effects on coastal processes were evaluated using a semi-quantitative criterion that balances the magnitude of change attributed to the new activity relative to the spatial area effected, permanence and detectability above natural environmental variability. This framework is presented in Appendix A where the level of effect (e.g. less than minor, moderate, significant) is defined specifically for coastal processes. The level effect for different project elements is summarised as:

- Construction effects on physical coastal processes outside the proposed area for dredging is considered ***minor***.

- Construction effects on physical coastal processes outside the proposed reclamation and seawall area is considered ***negligible***.
- The long-term effects of the proposal on currents, waves and associated sediment transport are assessed to be ***minor*** within Marsden Bay and the harbour seabed adjacent to the dredged area.
- There are ***no long-term effects*** expected within other areas of the harbour or within Bream Bay
- The expected long-term effects on existing and future coastal hazards are ***negligible***.
- Due to the minor changes to the currents and wave climate as a result of the shipyard reclamation the overall cumulative effect on coastal processes access is ***minor***.

Recommended measures to remedy or mitigate effects

There is no practicable way of avoiding all effects with the current proposal as there is occupation and disturbance within the Coastal Marine Area. The remainder of effects are minor or less and no mitigation is proposed for these.

Monitoring

The areas to monitor for long term potential change include Marsden Bay and the form and function of the proposed bird roost. Much of these areas are already subject to hydrographic survey, but intertidal and subaerial survey should be carried out at the same time to provide a comprehensive topographic and bathymetric data set. Surveys should be carried out after completion of each stage of the development and at least annually for a period of not less than five years.

Sediment sampling and analysis of surficial sediments within the eastern end of Marsden Bank could also be carried out to confirm any change in sediment properties that may potentially affect ecology in this area.

It is anticipated that the turning area will need to be dredged occasionally as part of the shipyard operations. Surveying of this area should be done annually and include the dredged extent including the side slopes and at least 500 m of seabed to the west and north of the dredged area.

1 Introduction

1.1 Background

MBIE is planning to develop a shipyard to the immediate west of the existing Northport facility. Northport is a deep-water commercial port strategically situated at Marsden Point near Whangārei in Northland, New Zealand. The MBIE proposal is to construct an approx. 9.7 ha reclamation immediately abutting the existing Northport facility to provide for a marine maintenance operations facility, incorporating a 'cutout' where a floating dry dock or potentially a ship lift is to be located enabling vessels to be docked; space on the reclamation is provided for vessels to be transferred to hardstand either longitudinally or laterally from the 'cutout' with sufficient space for buildings necessary to accommodate necessary ancillary plant, material and activities; and space for access to and around the facility.

MBIE commissioned Tonkin + Taylor (T+T) to assess the potential effects of the proposed activities on coastal processes. Due to the location of the proposed shipyard and dry dock facility to the west of the existing port, the effects of the Project on coastal processes that occur east of the existing port are likely to be insignificant. Therefore, this assessment focusses on the tidal inlet, Marsden Bay and the estuarine harbour environments in proximity to the site of the proposed facility.

This report makes use of the following reports to inform the assessment of effects on coastal processes prepared for this study:

- MetOcean Solutions (2020a) Hydrodynamic modelling: modelling update, report prepared for Northport, September 2020
- MetOcean Solutions (2020b) Morphodynamic modelling for the Northport environment: modelling updated, predicted morphological response to proposed capital dredging and land reclamation, report prepared for Northport, September 2020
- MetOcean Solutions (2021a) Hydrodynamic modelling: full vision for growth scenario layout, report prepared for Northport, February 2021
- MetOcean Solutions (2026a) Hydrodynamic modelling MBIE 2026 update: effects of proposed reclamation and dredging layout on hydrodynamics, Report prepared for MBIE, July 2026
- MetOcean Solutions (2026b) Morphodynamic Modelling MBIE 2026 update: effects of proposed reclamation and dredging layout on morphodynamics, Report prepared for MBIE, July 2026
- MetOcean Solutions (2026c), Dredge plume modelling: dredging plume dispersion over existing and proposed port configurations. Report prepared for MBIE, July 2026
- T+T (2022) Vision for Growth Port Development: Coastal Process Assessment, report ref. 101738.V2, September 2022

The report also relies on involvement in, and previous studies for, Northport, the Whangarei approach and channel deepening and realignment project for Refining NZ (now Channel Infrastructure), and other consent processes.

1.2 Methodology

The assessment was initiated with a baseline information assimilation, compiling and updating information from our previous assessment in 2022. This included additional bathymetric surveys from Northport, new aerial photographs and LiDAR data from LINZ. A low tide site visit of Marsden Bay was also carried out together with the avifauna and marine ecology experts.

Our assessment of coastal process effects was the done utilising the information assimilated and the findings from hydrodynamic and sediment transport modelling carried out by MOS. We also carried out an assessment of natural hazard risk of the proposed development using the risk framework set out in the National Policy Statement -Natural Hazards.

1.3 Report layout

Section 2 sets out the description of the project, with the physical setting and coastal processes described in Sections 3 and 4 respectively. The assessment of effects of changes in physical coastal processes is set out in Section 5. Section 6 includes a brief assessment of the proposal in terms of the National Policy Statement-Natural Hazards, in terms of coastal inundation, erosion and tsunami. Section 7 identifies any proposed avoidance, reduction and mitigation measures and proposed monitoring conditions are set out in Section 8.

1.4 Datums and coordinates

All levels within this report are presented in terms of New Zealand Vertical Datum. Coordinates are presented in terms of New Zealand Transverse Mercator (NZTM). The relationship between NZVD and Marsden Point Chart Datum is shown in Figure 1-1.

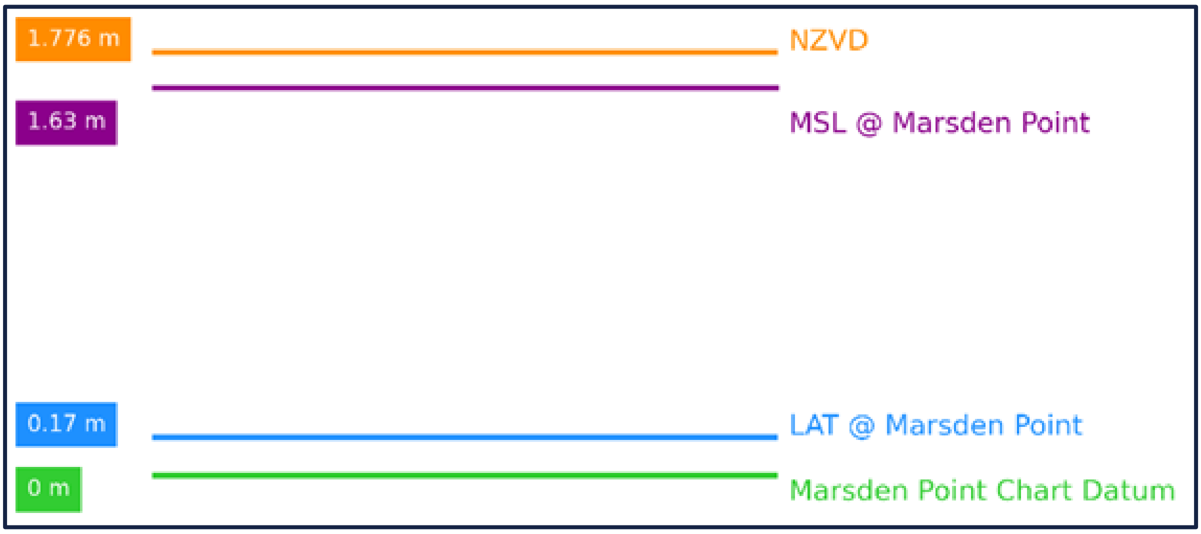

Figure 1-1: Vertical datum relationship at Marsden Point (Source: MOS, 2026)

2 Description of the proposal

2.1 Overview

The NDD project involves the development and operation of a marine maintenance operations facility abutting the western side of the existing Northport port facility at Marsden Point, Whangārei Harbour. The project includes a reclamation, vessel haul-out system, and associated wharf structures, dredging, and supporting infrastructure. A **spatial overview plan** (Figure 2-1) shows the extent of the proposed reclamation and piled suspended deck structure, and the extent and depth of dredging for the stage one extent. Key components of the project include:

- Reclamation of approximately 9.7 hectares
- A `cutout` to the reclamation where a vessel haul out system is to be located, being a floating drydock or potentially ship lift or other lifting mechanism
- Construction of a piled wharf structure to accommodate vessels either temporarily (before/after haul-out), or for extended periods where works not requiring haul out can be undertaken
- Dredging stage one: capital and maintenance dredging associated with construction and ongoing operation of the marine maintenance operations facility, including a berth pocket and a vessel turning basin to provide for safe navigation. The total dredge volume for stage one is around 753,209 m^3
- Dredging stage two: capital dredging to ensure sufficient volume of dredge spoil is available to construct both the Northland Dry Dock (NDD) and Northport's Vision for Growth development. This includes an additional 710,600 m^3 to be dredged within the dredge footprint area of the Northport consented area (Figure 2-2).
- Capital and maintenance dredging associated with construction and ongoing operation of the marine maintenance operations facility, including a berth pocket and a vessel turning basin to provide for safe navigation.
- Fixed plan and buildings to accommodate marine maintenance activities and materials
- Sufficient working and laydown areas for maintenance operations, including the ability to transfer vessels to hardstand
- Access to and around the marine maintenance operations facility including a landside area for staff carparking
- Public access around the edge of the reclamation to a public fishing platform.

The marine maintenance operations facility is to provide vessel maintenance, repairs, and servicing, including but not limited to cleaning, painting, and repair of commercial and naval vessels, including Cook Strait ferries and Royal New Zealand Navy logistics vessels, along with other vessels such as international freight vessels and super yachts. The facility has design capacity to accommodate vessels ~50m to 230m in length with displacement between 500t and 28,000t. The facility will be based on normal working hours of 7am-6pm but the capacity to operate 24/7/365 where required, subject to appropriate restrictions on noise-generating activities.

The location of the facility has been carefully selected for functional and operational requirements, including the need for deep water access, sheltered harbour conditions, proximity to existing port services, sea and land transport links, and integration with established and proposed marine and land-based industrial infrastructure.

The project is listed in Schedule 2 of the Fast-track Approvals Act 2024 as having significant regional or national benefits.

We have assumed dredging will be carried out by either Trailer Suction Hopper Dredge or Cutter Suction Dredge, with a Backhoe Dredge required in the more confined areas.

Maintenance dredging will be necessary, particularly within the first few years following the capital dredging as side slopes settle, mainly along the western side slopes of the dredged cut. The over deepened area to provide additional reclamation sediment will be allowed to fill in until the minimum draft levels are reached.

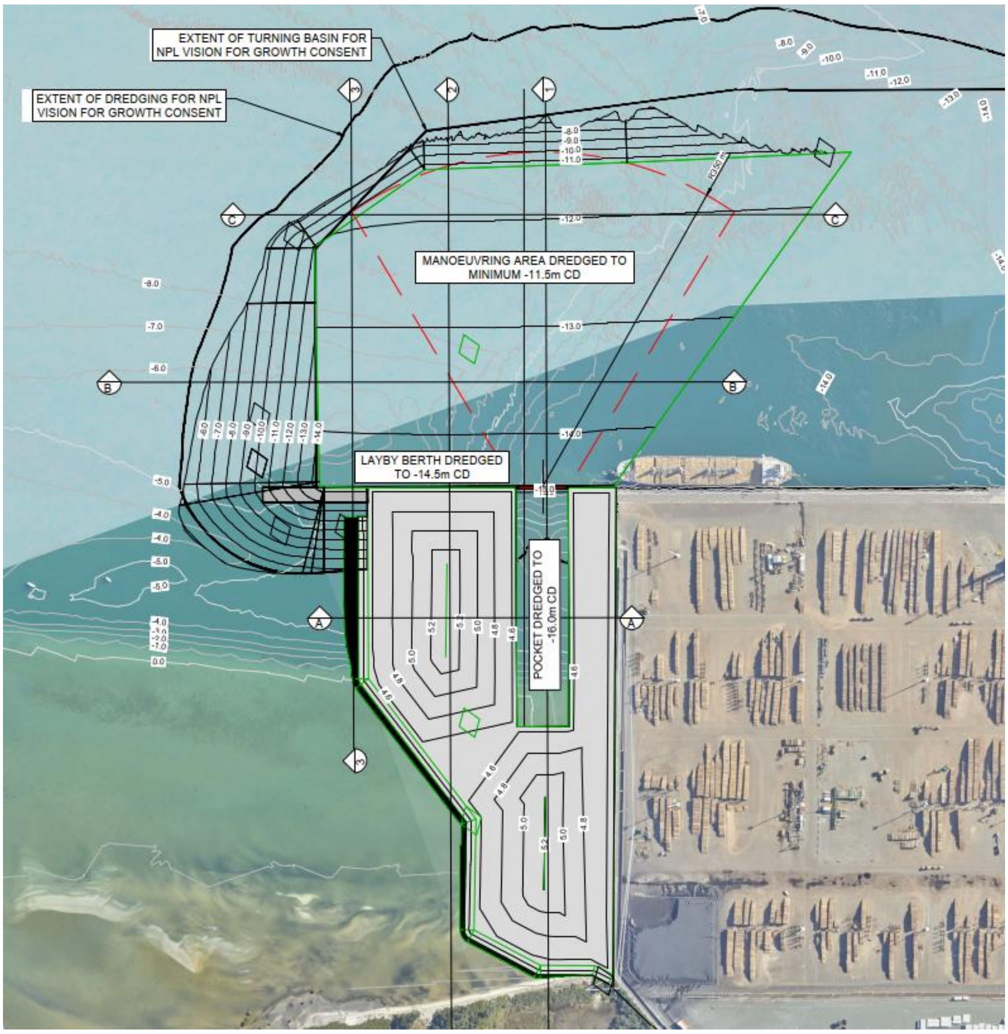

Figure 2-1 Spatial layout of the proposed facility with the stage 1 dredging footprint indicated by the green line

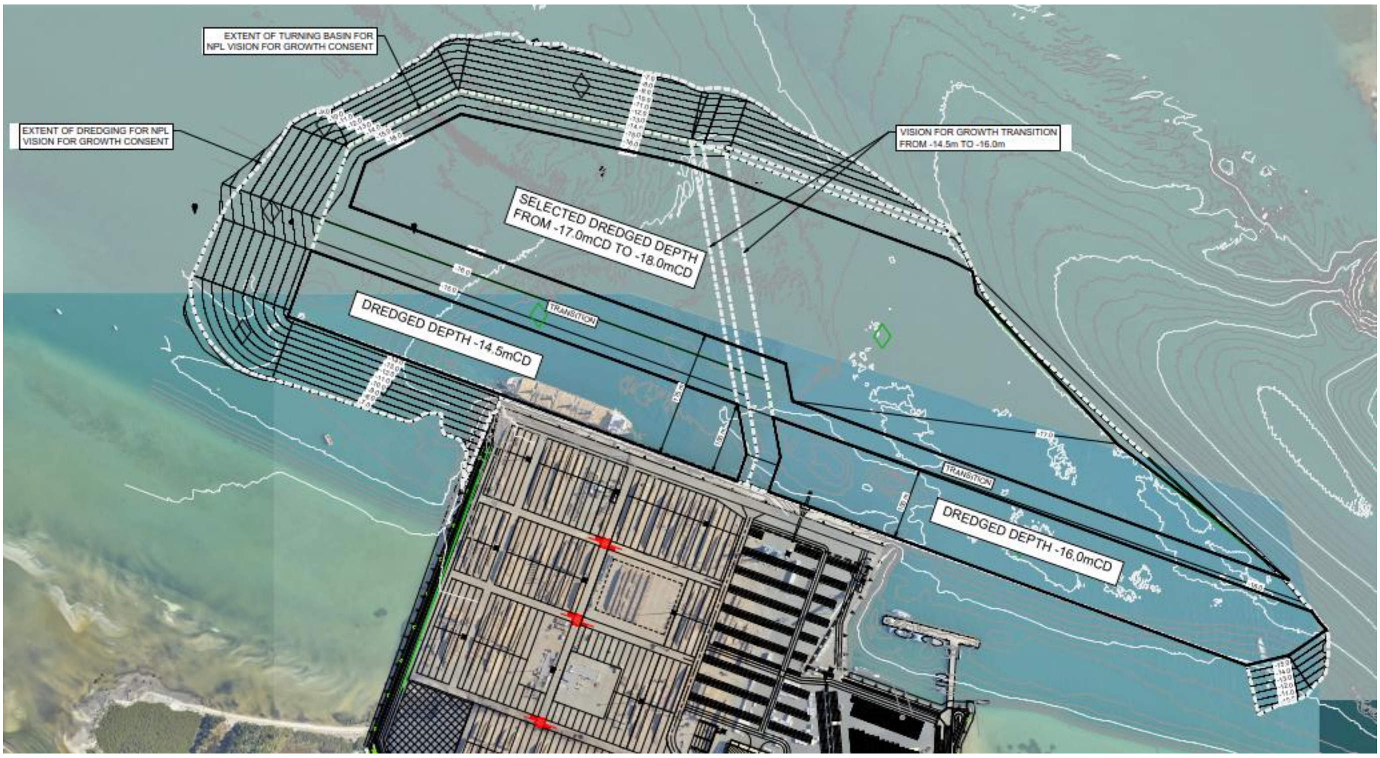

Figure 2-2: Stage two dredging area to provide additional fill is within the Northport dredge area and locally deepens the seabed

2.2 Revised shape and location of the bird roost

2.2.1 Background

As part of Northport's existing consents, they are required to build a bird roost, to be located on the western side of the existing Port facility. The consented bird roost location will be close to the proposed reclamation for the shipyard and drydock facility. As set out in her report, Dr Bull considers the sand bank / bird roost is too close to the proposed reclamation for bird comfort on the roost. Accordingly, and in consultation with Dr Bull, this report has considered where the sand bank / bird roost may be relocated to, and any coastal process effects associated with that. As part of this, consideration has been made of the greater ecological values of the intertidal area to the west and the proximity of the wetland behind the sand spit.

2.2.2 Requirements

The purpose of the bird roost is to mitigate for the area of around high tide beach of around 20,800 m^2 lost due to the eastern reclamation. The proposed bird roost needs to in a similar location to the currently consented roost and:

- Be independent from the existing shoreline during high tide to provide a safe area
- Be largely, or completely formed from sand to provide a similar habitat to that lost
- Provide a reasonable area above mean high water springs
- Be situated away from ecologically significant areas
- Be sufficiently far from any identified wetland areas

- From a constructability and practical point of view it was also important to locate the roost in an intertidal area to reduce the volume of fill and the occupation area in the CMA.

2.2.3 Potential sand sources

Practical sand sources for the roost are either won sand from the dredging process or beach sand from the area to be occupied for the shipyard. The sand source from dredging includes sandy silt and silty sand (MOS, 2026b) and includes up to 30% silts, but typically around 14% with predominantly fine to medium sands. Beach sediment is likely to have less fines and a D10 of around 0.1 mm, a D50 of around 0.2 mm and a D90 of around 0.3 mm with no significant proportions of silt. However, both dredged sand or sand sourced from a beach area to be occupied by the reclamation will likely need processing and rework to remove the fines and to only retain clean medium to coarse sands and shells/gravel.

2.2.4 Form of the roost

A circular sand bank / bird roost with similar footprint and elevation as the original design is proposed. The location and general form of the proposed roost compared to the Northport consented roost location, is shown in Figure 2-3. The proposed sand bank / bird roost will have a crest level of around 1.6 m RL, or around 0.6 m higher than MHWS. This will ensure that the surface is not frequently inundated by waves at high tides.

The structure has an area at MHWS of around 2,700 m^2 with side slopes of around 8(H):1(V) and occupies around 7,480 m^2 of the intertidal seabed. The initial structure will require around 7,200 m3 of sand. The cross section of the roost was informed by the slopes and elevation of the existing shoreline.

Alternatives, such as using rock armour or vertical walls to create a stabilised northwestern edge could result in a slightly smaller footprint and be more stable but would restrict bird movement down the face of the roost as the tide recedes and introduces a different form to the bay.

2.2.5 Construction approach

The preferred construction approach for the formation of the roost is a marine based approach, with sand either bought to the area at high tides with shallow draft barges and unloaded and shaped with hydraulic excavators or pumped to the proposed location, with temporary works, such as sheet piles, geobags or large blocks to confine the placed sand to the proposed location. Land based approaches were considered but are not practicable.

2.2.6 Expected performance of the bird roost

The proposed bird roost is situated in a relatively sheltered environment, with low tidal currents (typically less than 0.2 m/s) and generally low wave heights (typically lower than 0.2 m) with higher waves only likely to occur to this level during higher stages of the tide and during periods of strong north-westerly winds.

There is evidence that the existing barrier beach is slowly moving landward. This is likely a result of wave overtopping and over-wash, potentially exacerbated by higher sea levels that would allow slightly higher waves to act on the beach, as well as reduced sediment supply. The roost will create a more sheltered environment between the roost and the existing barrier spit. This sheltering is likely to result in a reduction of the landward retreat of the existing barrier beach at this location and is also likely to enable the existing mangrove to extend further seaward in the lee of the roost.

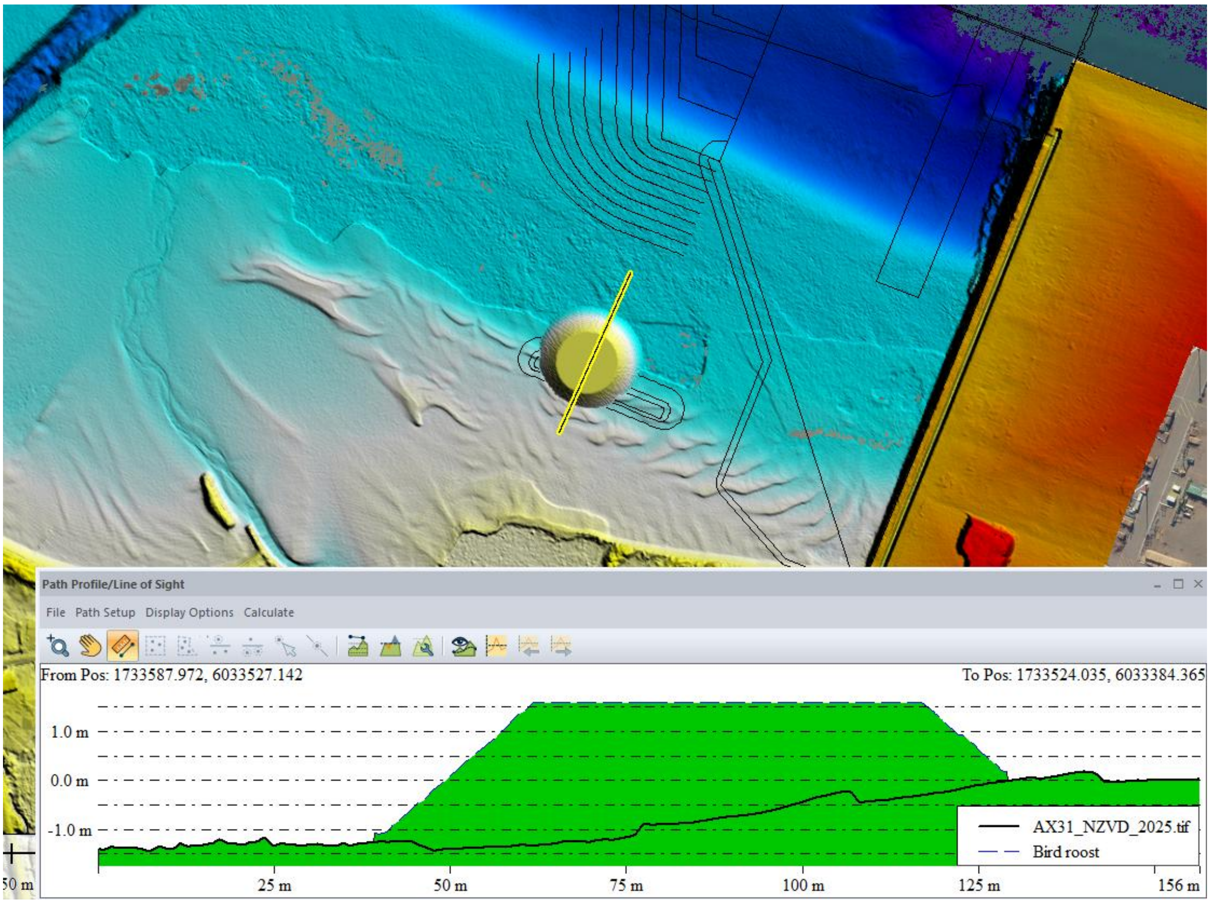

Figure 2-3: Alternative bird roost configuration (plan view and section)) to accommodate avifauna and ecological requirements. Note the outline of the Northport consented bird roost location is also shown on the plan.

It can also be expected that the proposed roost will gradually deflate and lower due to wave overtopping moving sediment landward. The deflation and lowering is expected to result in locally raising the seabed level between the roost and the landward spit feature and potentially merging with this spit.

The period that the bird roost will remain with a reasonable area above MHWS is difficult to predict. However, the evidence from aerial imagery suggest that the remnant spit feature has remained at this location since prior to the original port construction. It is anticipated that the proposed roost could remain effective for periods of years to decades, although it is likely that some sediment loss will occur. If over wash occurs, moving sand to the landward side of the spit, this could retain a crest area above MHWS, but with a progressive landward location. However, it also possible that if the roost deflates there could remain a high point, but below MHWS.

This means that top-ups of the roost may be required to maintain a reasonable high tide area. Therefore, there will need to be monitoring, and a top-up plan established as part of the management of this roost. We recommend a top up volume of 10% of the capital be allowed for (i.e., 740m^3) every five years, although the actual volume will be dependent on the performance of the roost.

2.3 Disposal areas

No other offshore or marine disposal areas, except for the bird roost, are proposed. It is anticipated that dredged material will be utilised as fill in the reclamation. Accordingly, no offsite disposal is provided for. However, if any offsite disposal is required, it will be to land.

3 Physical setting

3.1 Location

The project site is located within Marsden Bay to the west of NorthPort reclamation within the lower reaches of the Whangārei Harbour (see Figure 3-1).

Figure 3-1: Project location

Whangārei Harbour, located at the northern end of Bream Bay on the northeast coast of the North Island, is a meso-tidal 98 km^2 drowned river valley (upper harbour) estuarine system with a spring tide prism[1] of around 155 x 10^6 m^3 (Hume and Herdendorf, 1985). The harbour is relatively shallow (mean high-tide depth of 4.4m) due to extensive intertidal flats, particularly in the lower harbour which accounts for 58% of the high tide area (Swales et al, 2013). The harbour is typically unstratified and has minimal inputs of fresh water (Inglis et al., 2006). The Hātea River is the main source of fresh water to the harbour, with a mean annual flow of 1 m^3 s^{-1}. The Waiarohia and Raumahanga streams have mean annual flows of 0.35 m^3 s^{-1} and 0.34 m^3 s^{-1}, respectively (Reeve et al., 2010). During summer, most of the harbour is well mixed, while in winter the lower harbour remains well mixed.

The harbour is accessed through a relatively narrow tidal inlet which is around 790 m wide and 32 m deep at its deepest point. The inlet is bounded by Tertiary volcanic rocks on the northern side and a Holocene prograded sandy barrier spit on the southern side, which forms Marsden Point (Longdill and Healy, 2007). Several bays indent the northern shoreline of the lower harbour. The inlet channel separates a large ebb tide delta that extends seaward to around the 20 m depth contour (refer Figure 3-1). Mair Bank, situated largely within the intertidal and subaerial portion of the

[1] Tidal prism is the volume of water between low and high spring tides.

southern ebb tide delta, extends to the east of Marsden Point and Calliope Bank is situated on the northern side of the channel. Snake Bank and McDonald Bank are the two main flood-tidal deltas located within the harbour inlet embayment (Morgan et al., 2011).

The harbour shoreline along the shores of Marsden Bay is a sandy beach system. The sandy beach comprises fine sand fronted by intertidal flats which range in width between 30 m and 200 m out to the entrance channel. The shoreline transitions to weakly consolidated cliffs extending from the western end of Marsden Bay to One Tree Point.

3.2 Geology

GNS Science geological maps show a very variable geological nature (displayed on Figure 3-2). According to Allen (1951bell), Whangārei Harbour has experienced relatively recent submergence followed by considerable infilling. Other work indicate that the Harbour may technically be termed an estuarine lagoon (Swales et al., 2013), however a number of tectonic movements may have contributed to the harbour's formation. These include a combination of tectonic activity, ancient block faulting, the formation of a drowned river valley and the existence of a barrier enclosing the mouth of the former valley.

The oldest rocks in the Marsden Point area are Palaeozoic greywackes and argillite of the Waipapa Group. These rocks outcrop north, south and southwest of the harbour and constitute the basement to Quaternary costal and estuarine sediments at the site. Although Tertiary sandstones, mudstones and limestone overlie basal Waipapa Group rocks and outcrop west of Ruakaka and at Mangawhai Point, these rocks are discontinuous and are not encountered in the Marsden Point Area.

Andesitic agglomerate, lava and dikes and small areas of andesitic tuffs, cones and lava outcrop with Tertiary mudstones and together comprise the Whangārei Heads, directly across the Whangārei Harbour (NE) from the site. The low-lying Marsden Point area comprises Quaternary aged older foredunes higher terrace deposits and undifferentiated sands with rare peaty areas, collectively described as alluvium. The site is located between two parallel inferred faults orientated northwest to southeast (see Figure 3-3). To the west, a fault in part concealed beneath recent alluvial materials extends along the Ruakaka River Valley and the Otaika Stream. The second fault, immediately north of the site is inferred to have resulted in the present harbour alignment. Neither fault is considered to be active.

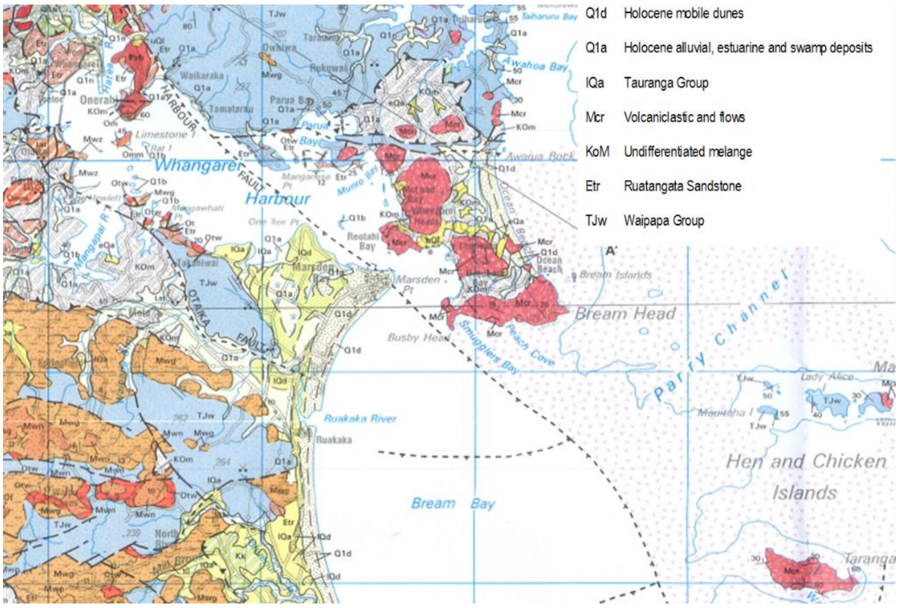

Figure 3-2: Geological Map, known faults are represented by solid and dashed lines (source: GNS 1:1,000,000 Geological Units)

3.3 Vertical land movement

Beavan and Litchfield (2012) assessed vertical land movement around New Zealand's coastline. They found Northland to be tectonically stable utilising both long-term geological markers and shorter-term GPS markers with Kaitaia and Whangārei exhibiting -0.3 mm/year and +0.3 mm/year trends respectively. The recently published vertical land movement information (https://www.searise.nz) show similarly low rates of vertical sea rise in the vicinity of Northport of -0.3 mm/year to -0.7 mm/year, although uncertainty ranges are significantly greater than the predicted rate (Figure 3-3).

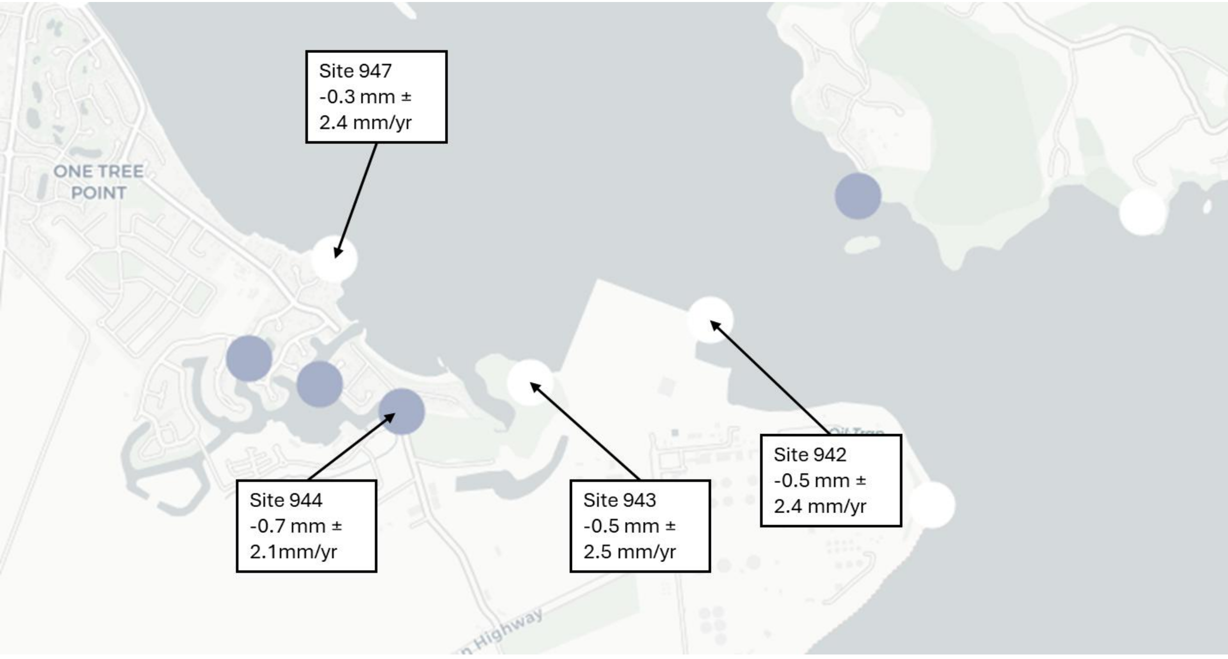

Figure 3-3: Rates of vertical land movement around Marsden Bay (Source: https://www.searise.nz)

3.4 Historical shoreline change

Historic aerial photographs from 1942 and 1971 were sourced from Retrolens (Figure 3-4) and aerial imagery in 2004 and 2025 (Figure 3-5) extending from Paradise Point to the west of Marsden Bay to Marsden Point. The 1940s shoreline was largely natural prior to port activities being established and was characterised by a spit branching off the shoreline at Marsden Point and more established spit seaward of Blacksmith Creek wetland formed by flood tidal currents.

By 1971 wharf infrastructure was already established at Marsden Point and some reclamation had occurred (Figure 3-3). The spit seaward of Blacksmith Creek wetland reduced in length and migrated landward by 35 m (1.2 m/yr). Marsden Bay become developed with housing and the coastal edge remained stable.

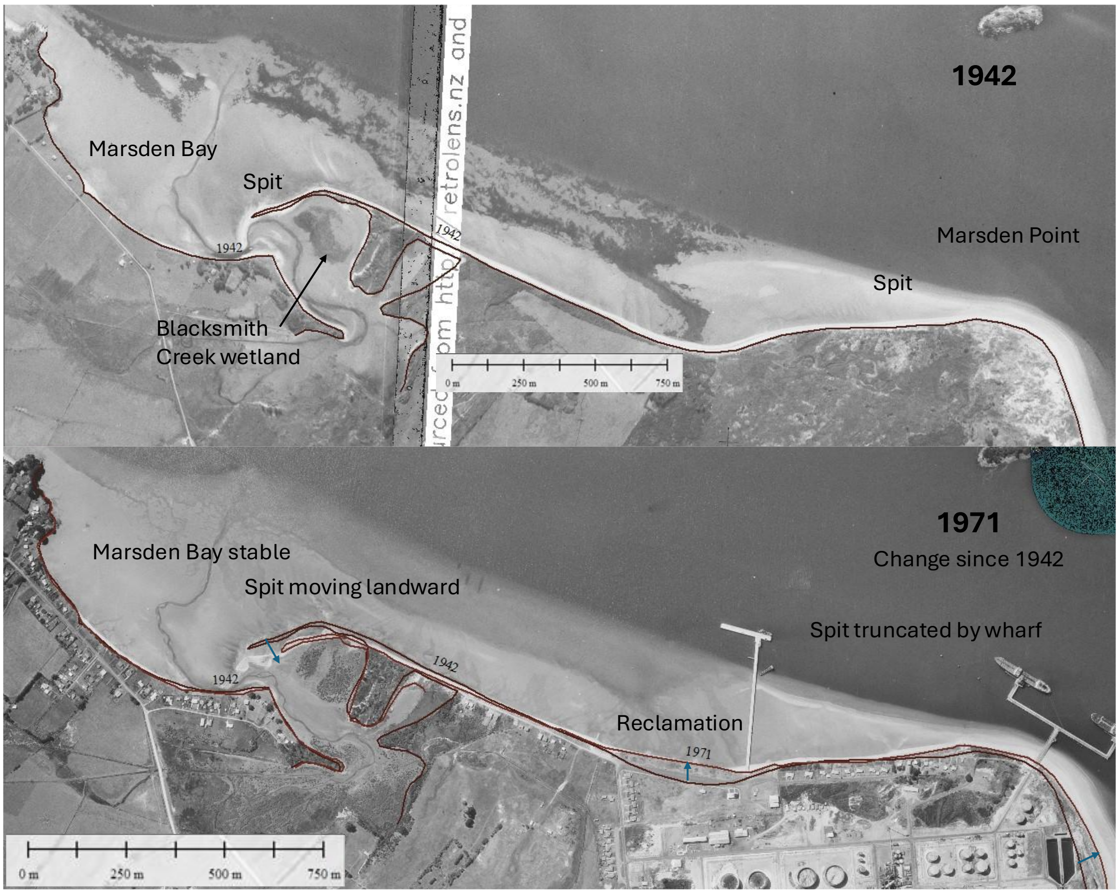

Figure 3-4: Historic shoreline changes from 1941 to 1971 (source Retrolens)

A coastal hazards assessment carried out in the 1990s (Gibb, 1988) identified that the cliff shoreline to the west of Paradise Point was in long term geologic retreat with erosion rates of between -0.02 to -0.1 m/year. Within Marsden Bay a long-term erosion rate was identified at the western end, and dynamic changes of both erosion and accretion at the eastern end of the bay, with the spit eroding at a rate of around -1.0 m/year.

Port reclamation by 2004 interrupted the natural sand flow from Marsden Point to Marsden Bay. The Blacksmith creek spit landward migration continued at a rate of 1.1 m/yr from 1971 to 2004 (Figure 3-5). Training structures were installed at the east end of Marsden Bay, at the Blacksmith Creek outlet, where some indication of erosion is visible in historic images (approximately 5 m since 1942). The Marsden Bay shoreline appears stable otherwise.

By 2015 the Waterways development at Marsden Cove was established, including a dredged boat channel through Marsden Bay with training wall breakwaters at the beach. A nourishment campaign also added significant volume to the beach, moving the shoreline seaward by 16 m. Between 2015 and 2025, the shoreline position appears largely dynamically stable with some temporal and local dynamics. The Blacksmith Creek spit continued a landward migration between 2004 and 2025 at a rate of 1.8 m/yr (Figure 3-5).

Figure 3-5: Historic shoreline changes from 2004 to 2025 (source Retrolens)

A comparison of terrain levels as surveyed by terrestrial LiDAR in 2020 and 2024 and terrestrial-marine LiDAR in 2025 (all data sourced from LINZ) was undertaken to assess recent coastal dynamics. To assist in this assessment the bay has been divided into the following segments (from west to east):

- The beach between the Paradise Point to the west and the Marsden Cove access channel
  - The beach and dune west of the waterways channel appear mostly stable within expected local dynamics.
- The beach between the Marsden Cove access channel and the outlet of Blacksmiths Creek
  - Construction of a rock revetment extension east of the access channel is associated with some end effect erosion where a 40 m section of dune has eroded by 5 m (Figure 3-6).
  - The main beach east of the Waterways channel was stable in terms of beach level and dune position, with some locations showing a trend of dune slumping, moving volume from the upper dune to the beach berm.

– The dune at the east end of Marsden Bay moved landward by approximately 1 m between 2020 and 2025, localised to a small section near the training wall.

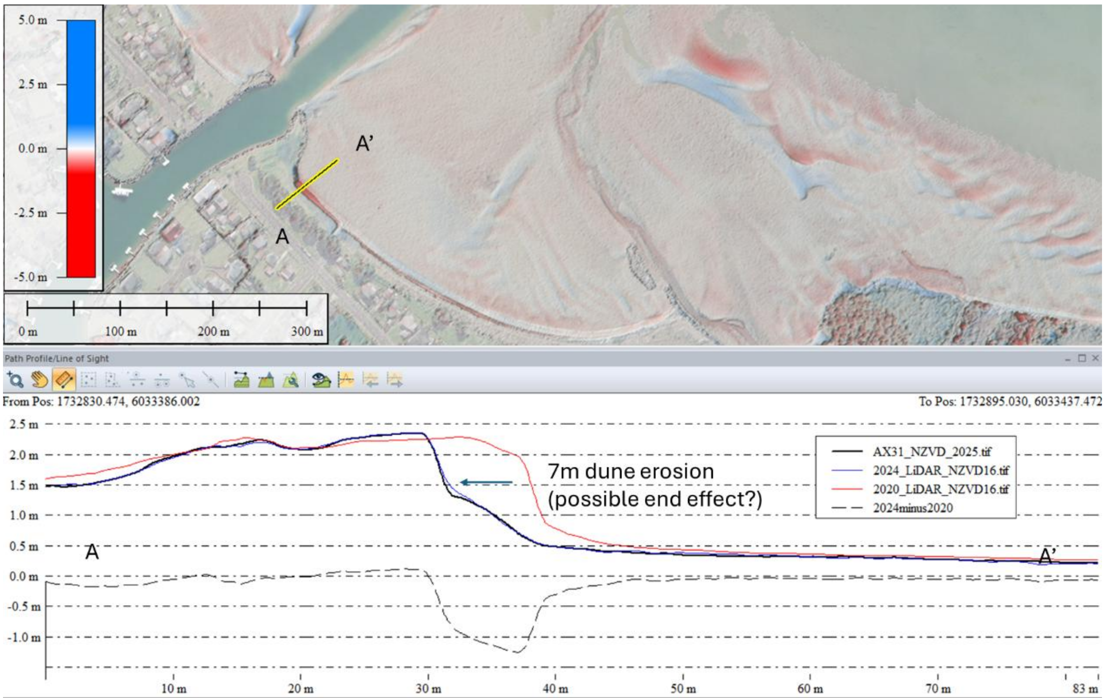

Figure 3-6: Terrain changes at western end of Marsden Bay beach

- The spit between the outlet of Blacksmiths Creek to the existing port reclamation
  – Intertidal bedforms seaward of Blacksmith Creek Spit are migrating landward, towards the southeast towards the corner of the port. This indicates shadowing from the easterly tidal currents by the port reclamation and influence of north and westerly wind wave action (Figure 3-7).
  – Landward roll-over of the terminal end of the spit.

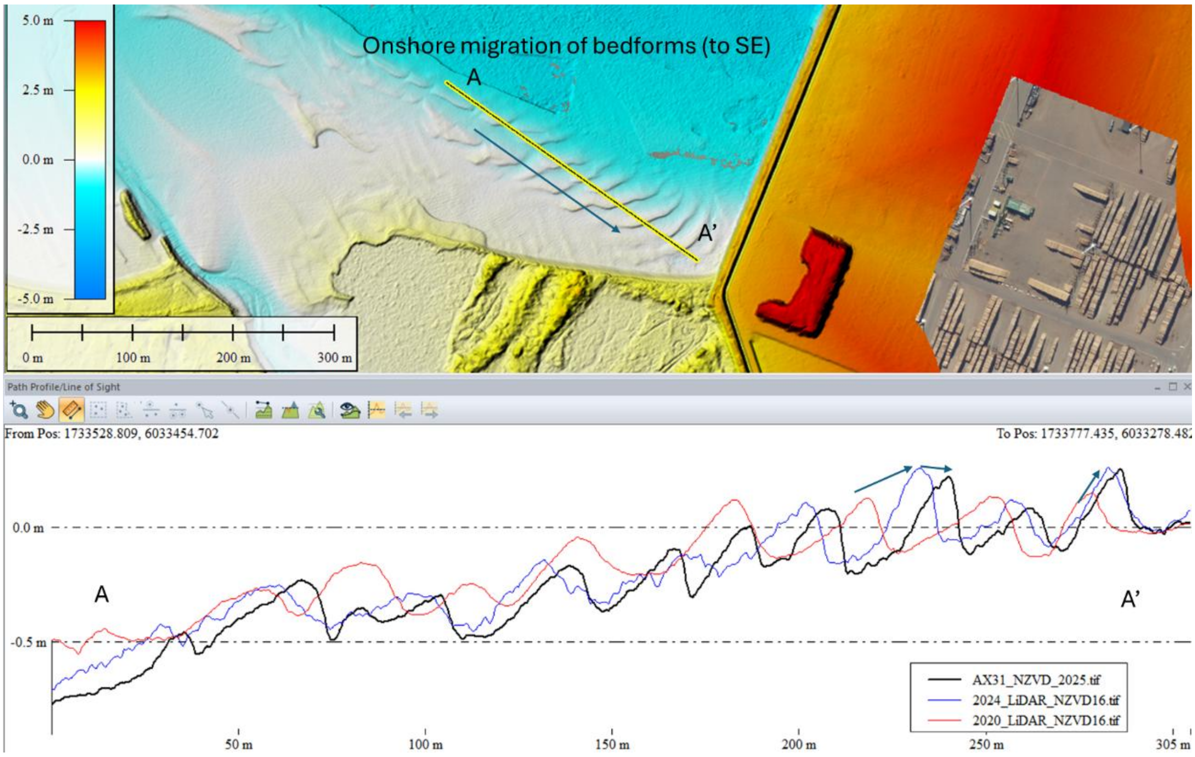

Figure 3-7: Terrain changes at Blacksmith Creak intertidal bedforms

3.5 Bathymetric changes

Bathymetry surveys from multibeam and single beam monitoring by Northport were reviewed to assess changes in seabed level between 2016 and 2026 using annual survey data for each year except 2017.

The difference in bed level between 2016 and 2026 is presented in Figure 3-8, showing 10 years of change. This data indicates a localised lowering of the southern ridge on the submerged area of Snake Bank, as indicated in red. The generally lowering is in the order of 0.5 to 1 m over a length of 400 m, concentrated to a narrow band. As the ridge transitions into the operational port basin, the trend becomes variable. From 2016 to 2018, the face of the slope moved seaward (into the port basin) by 30 m horizontally. A potential dredging campaign resulted in 60 m of landward movement from 2018 to 2019. Since then, a general infilling has occurred as indicated by the map in Figure 3-9.

Closer to the location of proposed works for the Dry Dock (Profile 1), the bed level on the ridge and basin floor is stable. The slope from the ridge towards the basin (going seaward) has accreted by 10 m in the last 10 years (horizontally by 1 m/yr) as indicated in Figure 3-10. The transition slope from ridge to basin wall is characterised by bedforms that appear to be migrating from Snake Bank towards the port basin (Figure 3-11).

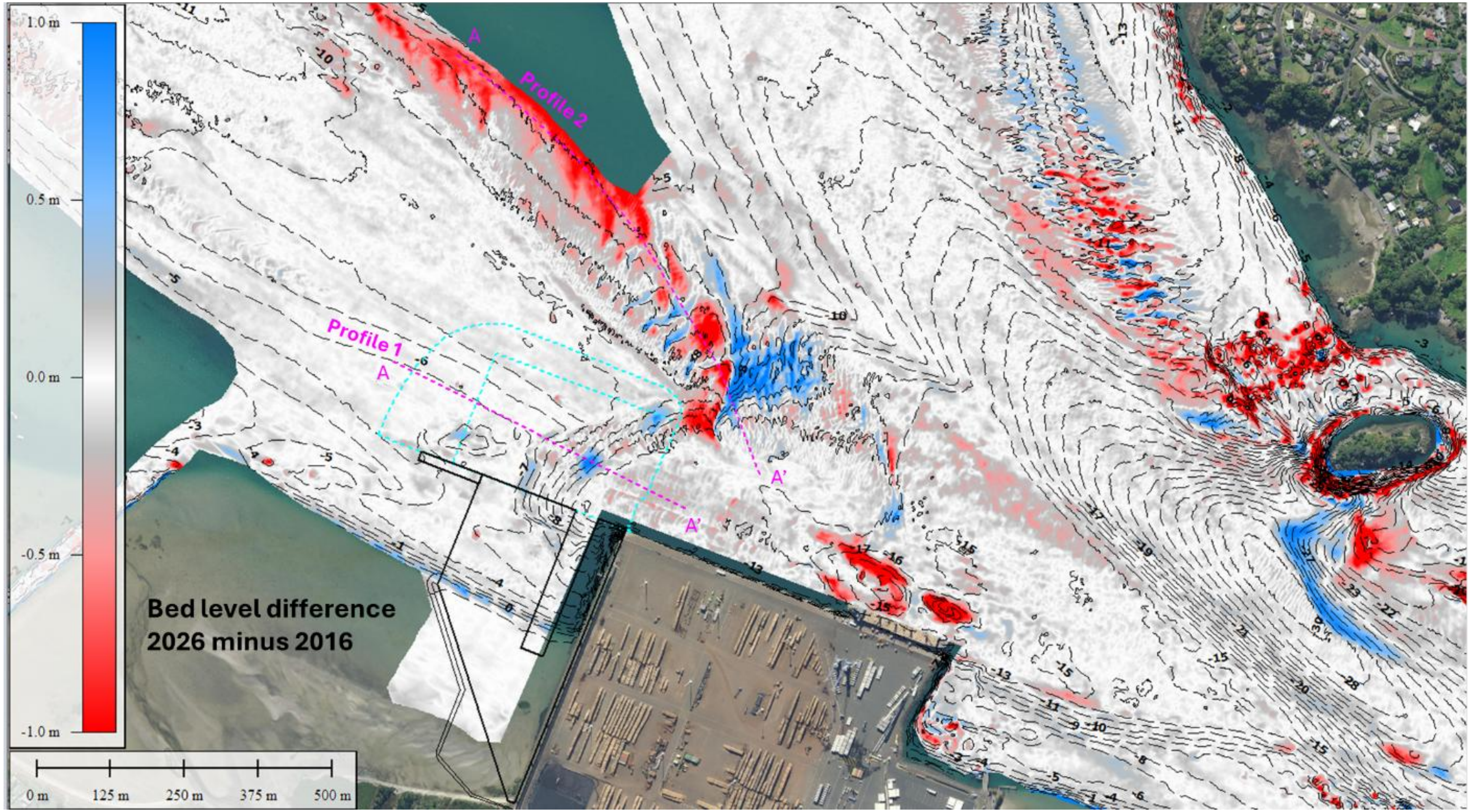

Figure 3-8: Bathymetric change 2016 to 2026. Red is lowering, blue is raising, dashed contours from 2026.

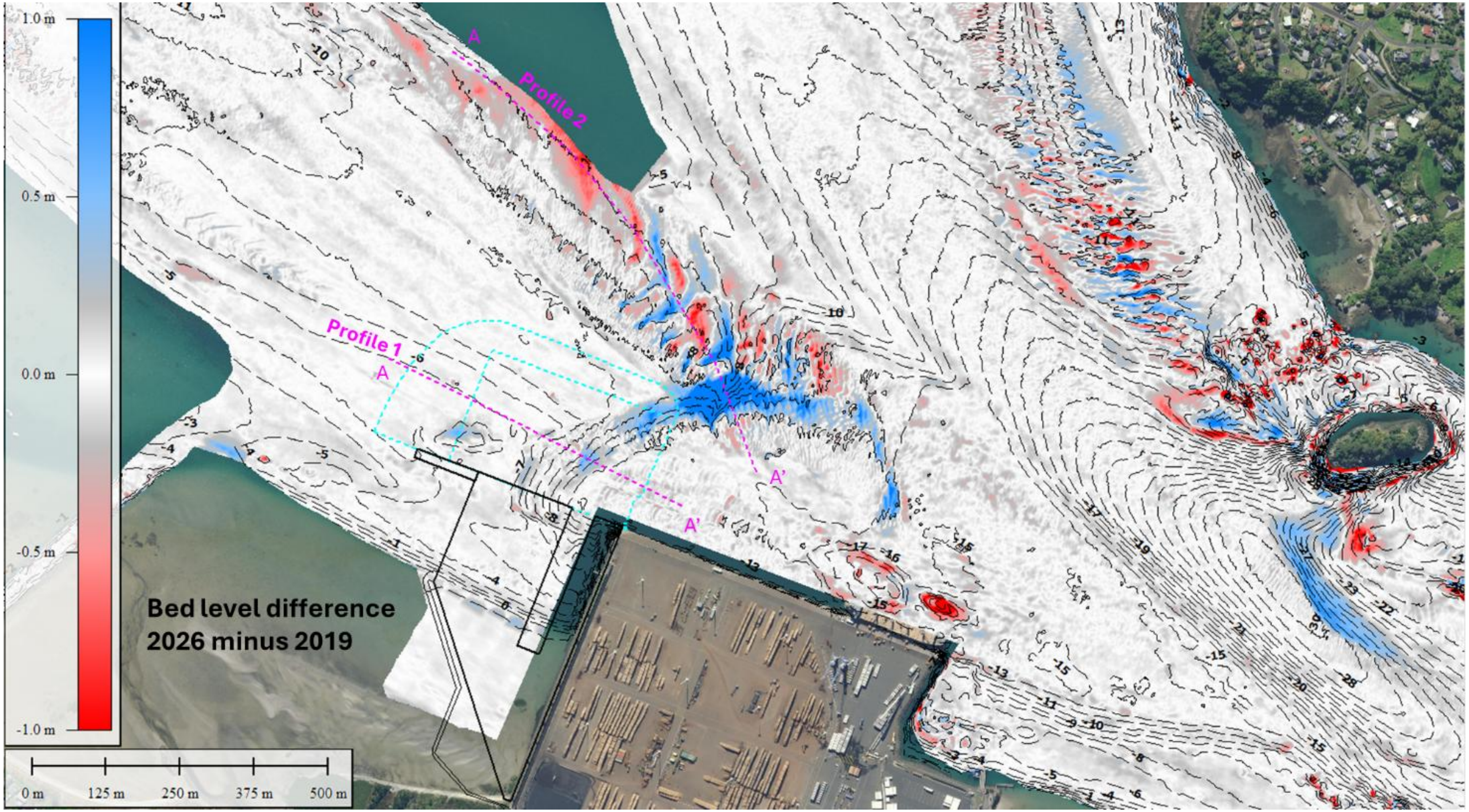

Figure 3-9: Bathymetric change 2019 to 2026. Red is lowering, blue is raising, dashed contours from 2026.

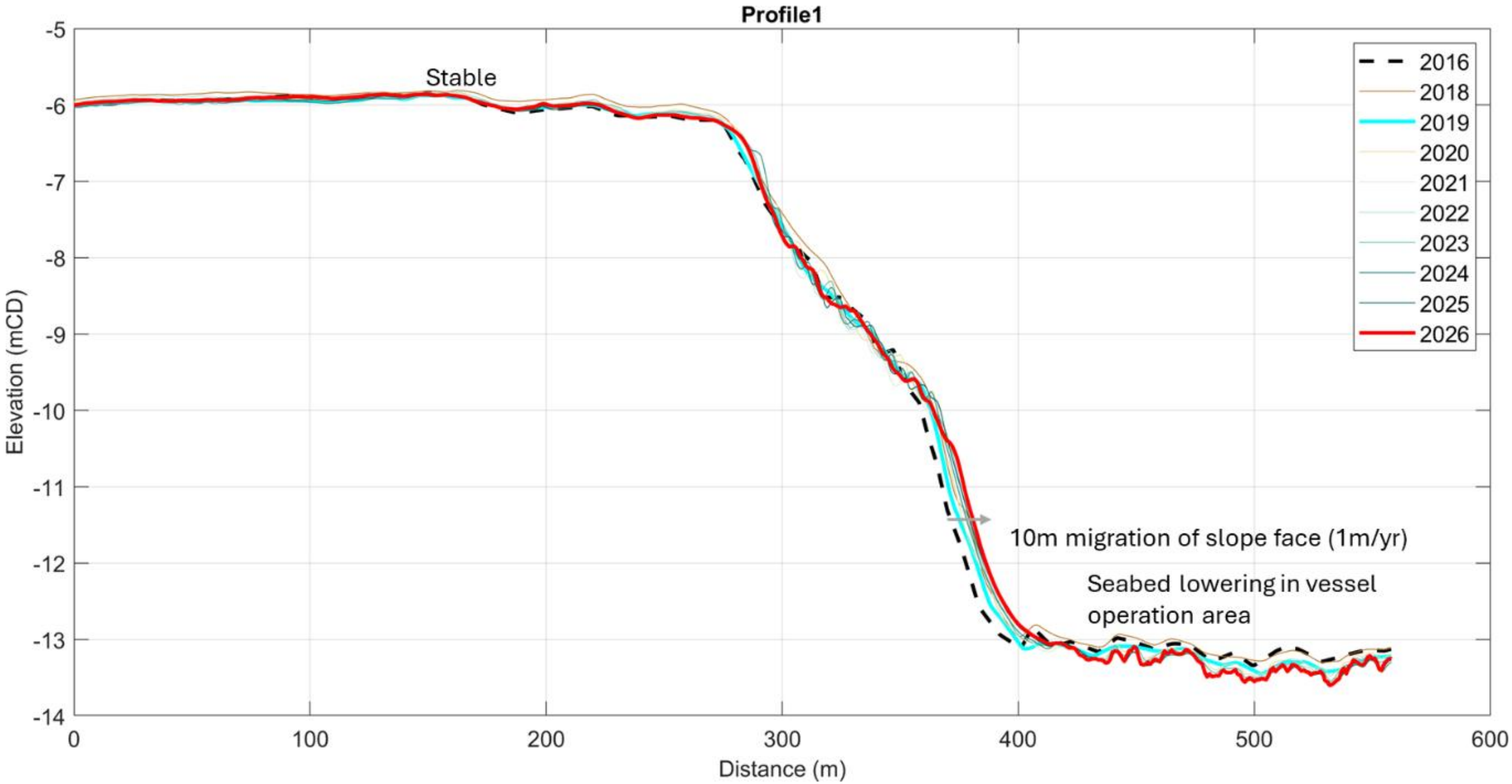

Figure 3-10: Bathymetric cross sections from 2016 to 2026 at Profile 1

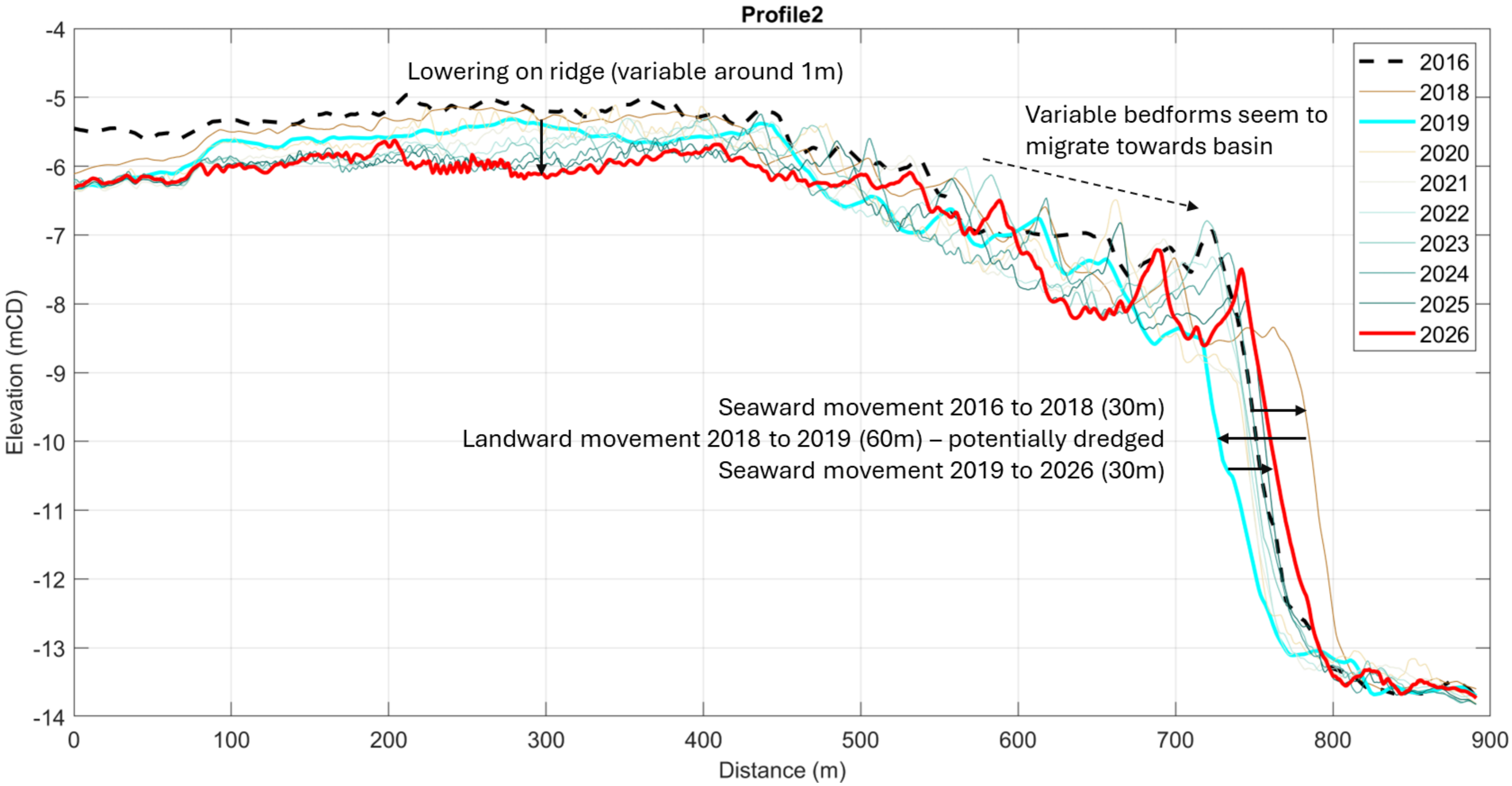

Figure 3-11: Bathymetric cross sections from 2016 to 2026 at Profile 2

3.6 Sediment data

Marine sediment data for the area in the vicinity of the dredging area is available from previous port development studies (Black et al. 1989, Hawthorn Geddes, 2009), Beca (1992), investigations commissioned by NRC (Swales et al., 2013) and summarised in the preliminary geotechnical report commissioned for the NorthPort reclamation (Initia, 2019). Figure 3-12 shows a schematic of the surficial sediment on the lower harbour bed based on interpretation of the various data sets and inspections. Figure 3-13 shows the seabed in the vicinity of the proposed shipyard and inferred geological sections based on borehole information. Section A runs from south to north immediately west of the existing port and Section C extends westward from the port along the base of the main channel. These sections show that there are interbedded layers ranging from loose to medium dense upper sands overlying an upper clay layer interbedded with sands that overlie dense to very dense lower sand layers.

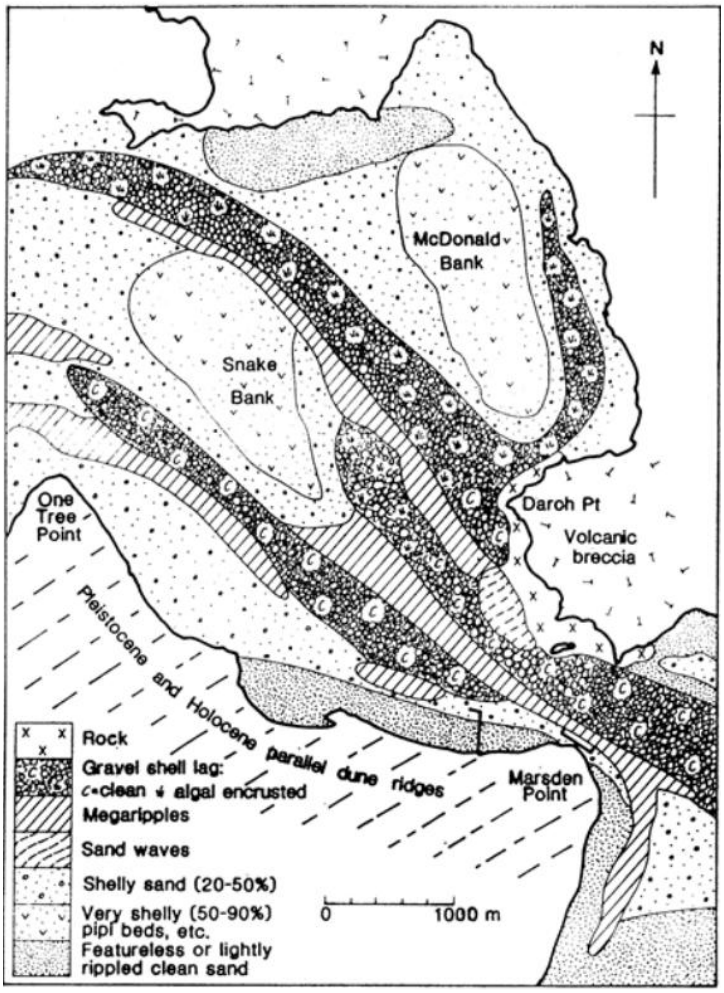

Figure 3-12: Simplified bottom sediment facies for Whangārei Harbour (Source: Black et al., 1989)

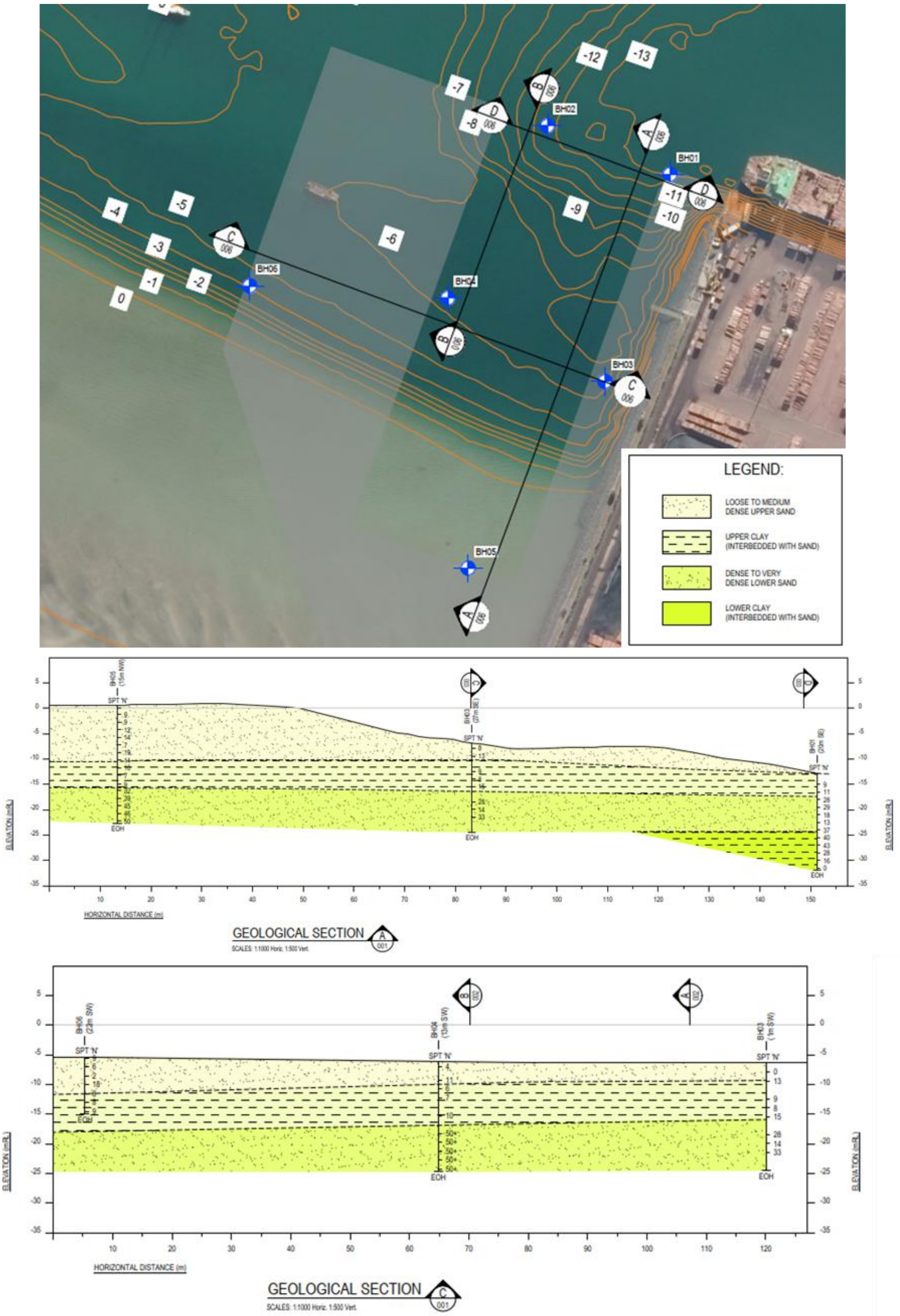

Figure 3-13: Location of boreholes and geological transects along Section A and C (Source: Initia, 2019)

3.6.1 Suspended sediments

Suspended sediment sampling was carried out by MWH (now Stantec) between June 2008 and May 2009 at four locations in the vicinity of the harbour entrance; at the harbour entrance, in the channel off Busby Head, south of Mair Bank and on the southern Ebb tide shoal (refer Figure 3-14). This information is still relevant and useful to show typical conditions at the site.

Figure 3-14: Suspended sediment sampling location plan (Source: MWH, 2009)

Average values of around 6 mg/L occur on the intertidal areas of the harbour seabed, while within the channel and ebb tide shoal areas, average values are also around 6 mg/L.

For the main channel and wider Bream Bay area, suspended sediment concentrations are relatively low apart from during more energetic wave events. Monitoring shows suspended solid values vary between 2 and 21 mg/L on the ebb tide shoal.

During higher wave energy events it is likely that suspended sediment concentrations within Bream Bay and Marsden Bay would be significantly higher than the values identified in the tables above. Table 3-1 shows the depth average sediment concentration at a water depth of 12 m for a range of higher energy wave events using the method of Van Rijn (1991). These results show that during more energetic wave driven events in shallower water depths there is significantly greater suspended sediment than the average conditions set out in the tables above.

Table 3-1: Depth average sediment within Bream Bay at 12 m water depth during higher energy events

Case	Significant wave height (m)	Peak period (s)	Percent occurrence per year (approx.)	Depth average suspended sediment concentration (mg/L)
1	1.5	8.6	10%	100
2	3.1	9	3%	600
3	5.0	11	1%	2,000

3.6.2 Summary of sediment properties

The sediments within the tidal inlet largely comprise medium to fine sands with a reasonable proportion of shell and low levels of silt. Typically, the suspended sediment concentration values are low, with around 6 mg/L within the tidal channel and on Mair Bank and up to 30 mg/L on the intertidal areas of the harbour.

3.7 Water level data

Key components that determine water level are:

- Astronomical tides
- Barometric and wind effects, generally referred to as storm surge
- Medium term fluctuations, including El Nino-Southern Oscillation (ENSO) and Inter-decadal Pacific Oscillation (IPO) effects
- Long-term changes in sea level due to wave transformation processes through wave setup and run-up.

We examine each in turn in the sections below.

3.7.1 Astronomical tide

Tidal levels for primary and secondary ports of New Zealand are provided by LINZ (2016) based on the average predicted values over the 18.6-year tidal cycle. Values for Marsden Point in terms of Chart Datum and NZVD are presented in Table 3-2. The mean tide range is around 2.23 m during spring tide and 1.35 m during neaps.

Table 3-2: Tidal levels given for Marsden Point

Tide state	Chart Datum (m)	NZVD - 2016
Highest Astronomical Tide (HAT)	3.04	1.26
Mean High Water Springs (MHWS)	2.74	0.96
Mean High Water Neaps (MHWN)	2.31	0.54
NZVD-2016	1.776	0
Mean Sea Level (MSL)	1.63	-0.15
Mean Low Water Neaps (MLWN)	0.96	-0.82
Mean Low Water Springs (MLWS)	0.51	-1.27
Lowest Astronomical Tide (LAT)	0.17	-1.61

Source: Standard port tidal levels | Marine information Guidance sourced 28/04/2026

3.7.2 Storm tide

The combined elevation of the predicted tide, storm surge and medium-term fluctuations is known as the storm tide. An extreme value analysis of hourly sea level data for Marsden Point was done using a Weibull distribution. Resulting extreme water levels for a range of return periods for Marsden Point are shown in Table 3-3. These results, provided by NIWA with respect to MSL (2010-2019), were corrected to NZVD2016 using offsets included in NIWA (2020) and offset levels provided by NRC (T+T, 2021).

Table 3-3: Extreme water levels (m) for Marsden Point

Datum	5-year ARI	10-year ARI	20-year ARI	50-year ARI	100-year ARI	200-year ARI	500-year ARI
NZVD-16	1.42	1.46	1.52	1.60	1.67	1.71	1.84
Chart Datum	3.17	3.21	3.27	3.35	3.42	3.46	3.59

3.7.3 Medium term fluctuations and cycles

Atmospheric factors such as season, ENSO and IPO can all affect the mean level of the sea at a specific time. Seasonal fluctuations and IPO phase changes can both be in the order of ±48 cm and ENSO fluctuations can be in the order of ±12 cm. The combined effect of these fluctuations are estimated to be up to 0.25 m (Bell, 2012).

3.7.4 Wind

A wind rose for Whangārei is shown in Figure 3-15. This shows that the predominant wind direction is from the west and southwest sectors, but that strong winds can also occur from the east. Winds are generally light for around 25% of the time and are strong for a similar proportion, although can be more frequently strong in Winter and Spring. Average wind speeds are less than 18 km/hr (5 m/s) although winds can exceed 61 km/hr (17m/s) for around 22 days per year but only exceed 96 km/hr (26.7m/s) for a few hours per year (Chappell, 2013).

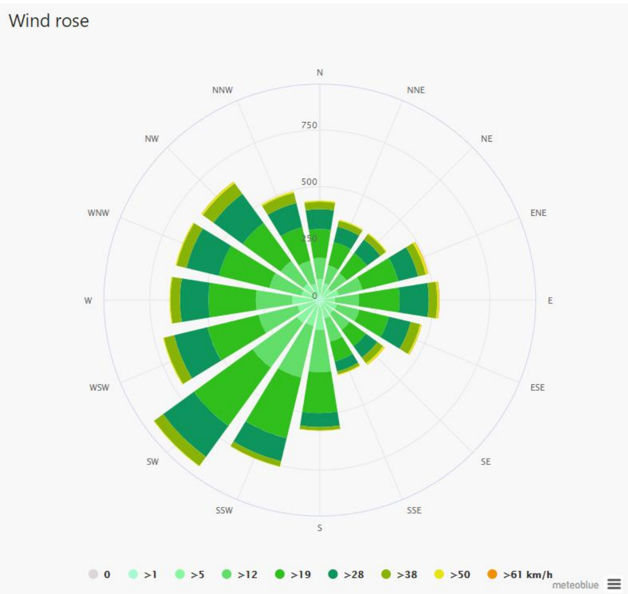

Figure 3-15: Windrose for Whangārei based on global weather models over a 30-year period with 30 km resolution (Source: meteoblue)

3.7.5 Wave climate

The wave climate in the vicinity to the harbour entrance has been modelled by MOS (2018b). This modelling shows that very little of the wave climate within Bream Bay propagates into the inlet of Whangārei Harbour (see Figure 3-16). This is due both to the sheltering effect of Mair Bank and the ebb tide delta as well as Whangārei Heads. Wave heights at the port from swell entering the harbour are typically less than 0.5 m.

Table 3-4 shows the significant wave height and peak periods of wind generated waves for a range of wind speeds at high tides with a water depth of around 2.3 m and a fetch length of 5 km which is representative of a north-western fetch to Marsden Bay. This table also shows wind generated waves are typically less than 0.5 m, except for the rare situation where winds exceed 61 km/hr.

Table 3-4: Wind generated waves heights within Marsden Bay for a range of wind speeds

Wind speed (km/hr)	Significant wave height (m)	Peak wave period (s)
5	0.04	1.0
12	0.10	1.5
19	0.17	1.8
28	0.25	2.1
38	0.33	2.4
50	0.42	2.7
61	0.50	2.9
96	0.80	3.5

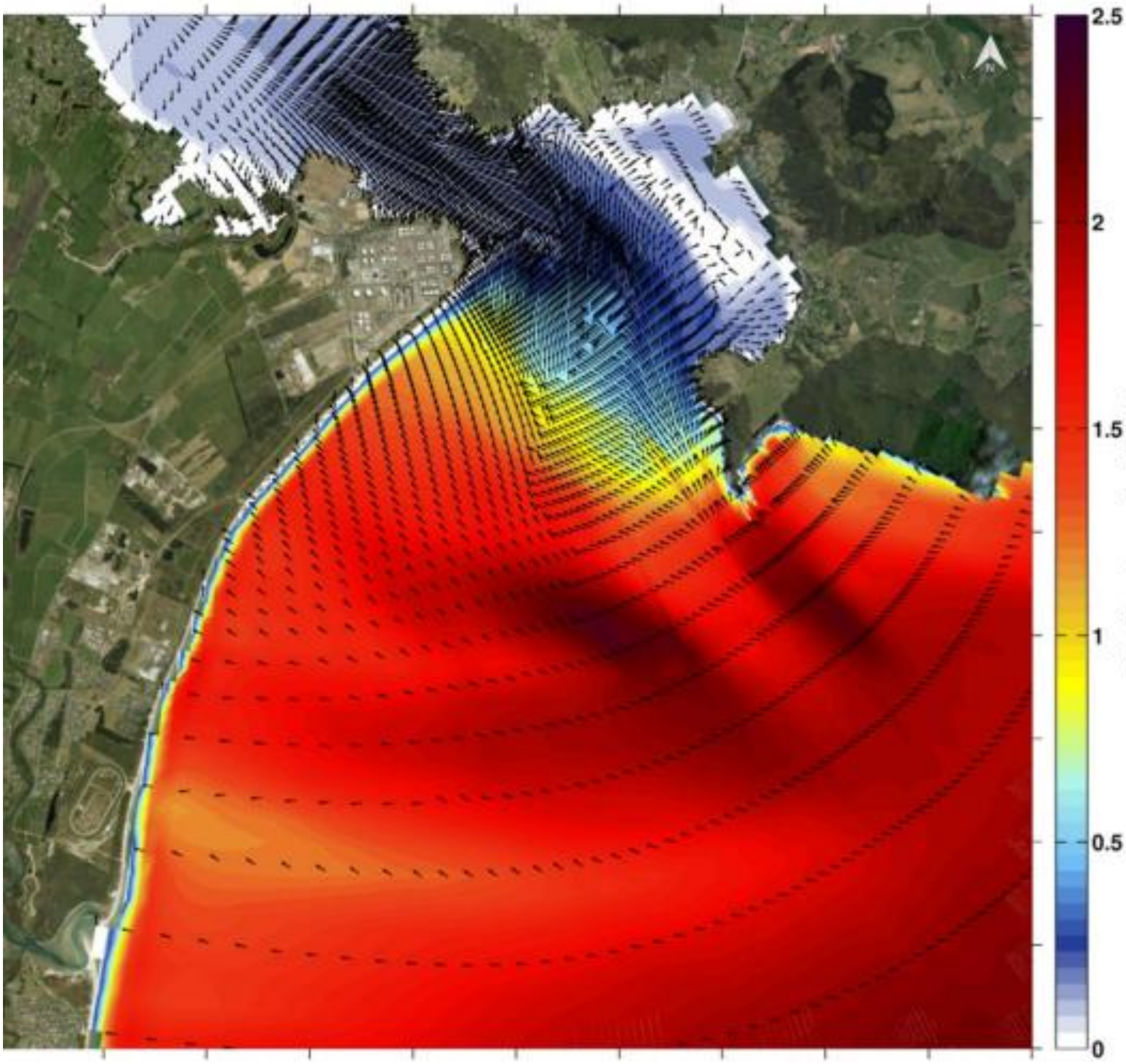

Figure 3-16: Significant wave heights of 2.5 m within Bream Bay shown to be significantly reduced at Northport due to sheltering effects of the delta and headlands (Source: MOS, 2018b)

3.8 Tidal currents in the vicinity of the harbour inlet

Previous studies identify that tidal current velocities gradually decrease up-harbour, from around 1 m/s at Marsden Point to 0.8 m/s at Limestone Island (Inglis et al., 2006). Tidal streams are strongest in the area adjacent to Home Point southeast of Marsden Point, where rates up to 1.5 m/s may be experienced (Inglis et al., 2006). The constricted tidal inlet results in currents reaching peak depth-averaged velocities of 1.1-1.3 m/s during spring tides (Black et al., 1989; Longdill and Healy, 2007).

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Tidal currents have been modelled by MOS (2018a) using a calibrated and validated hydrodynamic model for both the existing situation and with the deepened channel that CINZ has consent for. Figure 3-17 shows the present-day maximum ebb and spring tide velocities. During spring tide, the ebb tide creates the highest velocities along the edge of the ebb tide delta and Mair Bank with velocities reaching 1.3 m/s. Figure 3-18 shows the maximum velocities for the neap tide. In this situation the trend is similar to Black et al. (1989).

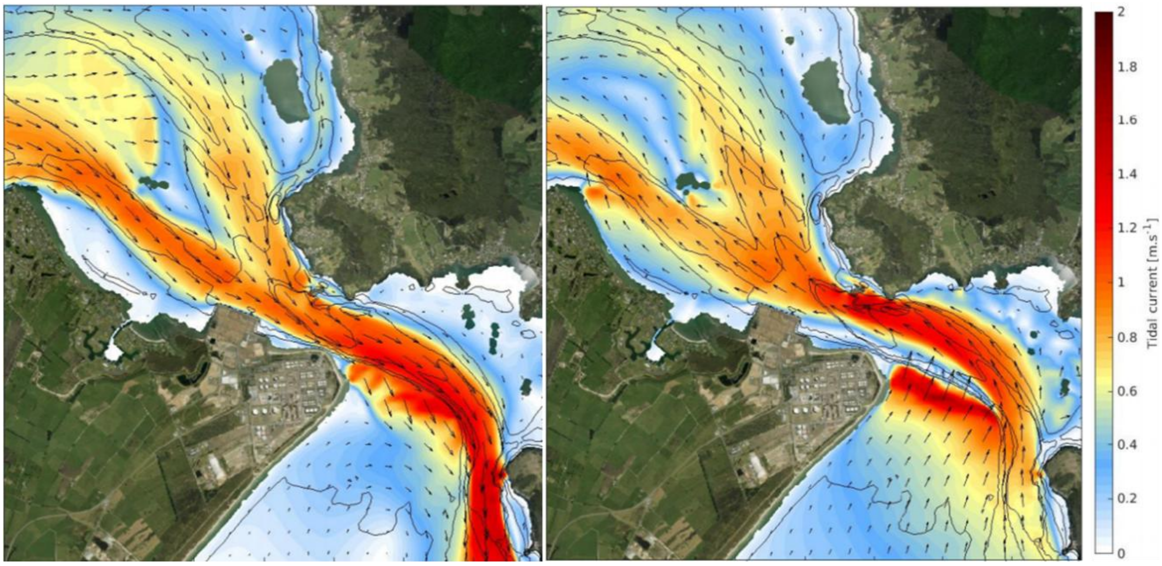


Figure 3-17: Modelled maximum ebb (left) and flood (right) spring tide velocities (Source: MOS, 2018a)

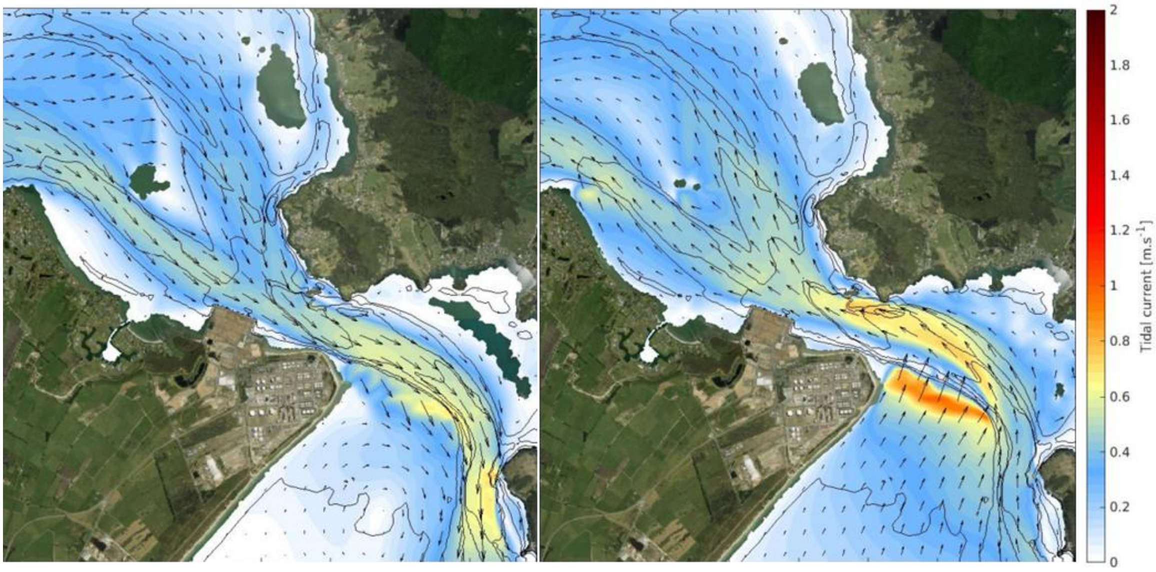


Figure 3-18: Modelled maximum ebb (left) and flood (right) neap tide flows (Source: MOS, 2018a)

Detailed flood and ebb modelling around Northport (Figure 3-19) show the formation of back eddies adjacent to either side of the port. These eddies can affect sediment transport pathways. The velocity residuals (Plot C) show very slight ebb dominance around the port, but with residual velocities less than 0.002 m/s.

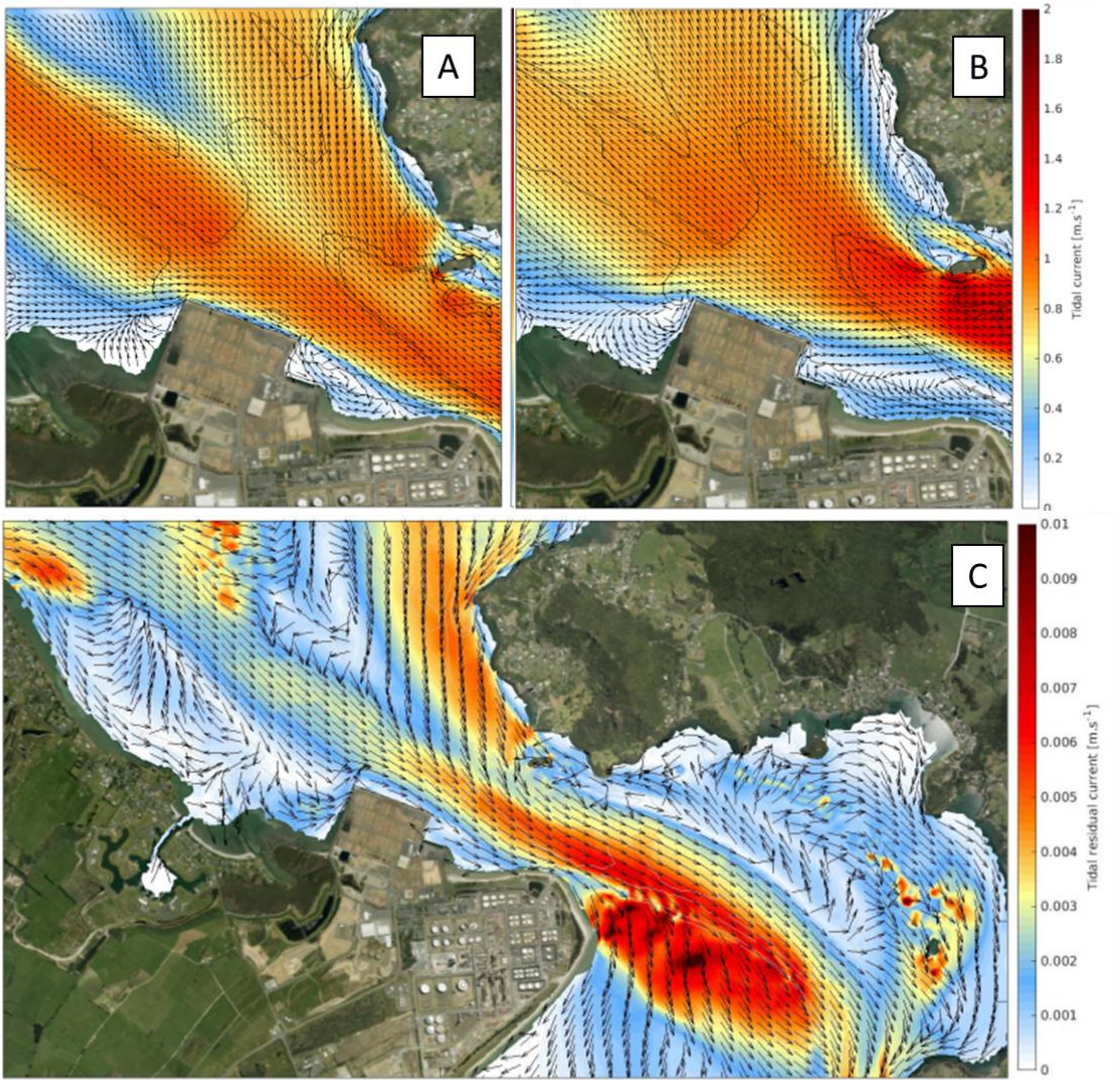


Figure 3-19: Modelled ebb (A) and flood flows (B) during spring tides showing eddies to the east and west of the port reclamation, with the difference between tides shown in (C). A and B have the same velocity scale. C has a different velocity scale (source: MOS, 2018a)

3.9 Tidal flux

Tidal flux is the rate of water flow through a defined area. Tidal flux was obtained from the tidal model at four locations as shown in Figure 3-20 extending from a transect from Marsden Point to Home Point within Bream Bay to a transect from One Tree Point to Reserve Point. Tidal flux was calculated for spring and neap conditions for both flood and ebb tides. The result of this analysis is shown in Table 3-5. The results show tidal flows are predominantly ebb dominated, with higher peak ebb flows than flood flows apart from the more open coast transect from Marsden Point to Home Point, where flux is slightly flood dominated.

Figure 3-20: Location of transects (yellow lines) to calculate tidal flux

Table 3-5: Changes in peak tidal flux

Tide stage	Transect location	Tidal flux (m^3/s)		
		Ebb	Flood	Difference
Springs	One Tree Point	9,778	8,823	955
	Northport	12,773	11,657	1,116
	CINZ Jetty	12,439	12,187	252
	Marsden Point to Home Point	16,378	13,411	2,967
Neap	One Tree Point	4,614	3,601	1,013
	Northport	5,876	4,650	1,226
	CINZ Jetty	6,241	4,555	1,686
	Marsden Point to Home Point	6,369	6,487	-118

3.10 Tsunami

Northland Regional Council contracted NIWA to undertake an initial study on the risk of tsunami inundation facing communities in the Northland Region (Arnold et al., 2011). Two credible sources were modelled: one for a South American origin with a return period 50-100 years, and a less frequent tsunami event with moment magnitude scale (M*) 8.5 and M* 9.0 from the Tonga/Kermadec Trench. The return period of the Tonga/Kermadec Trench events is much longer (500-2000+ years) and represents a worst-case scenario for a tsunami striking the Northland coast. These results show relatively low levels of inundation in the vicinity of the harbour entrance and that inundation is greater for the South American tsunami. Similarly, velocities within the tidal inlet are higher, with velocities of up to 3 m/s, approximately double the tidal velocities. The additional 0.5 m of sea level rise from climate change results in small increases in velocities. Results of the MHWS inundation depth and velocity plots are included in Figure 3-21 and Figure 3-22 for the South American tsunami with and without 0.5 m sea level rise.

The large velocities that occur because of the tsunami can potentially cause large scale changes to the physical system. This is likely to manifest in scour along the inlet and along Mair Bank and deposition both within the inner harbour and offshore. Over time a proportion of the transported sand may return to the ebb tide shoal system, but there may also be some volume that is not able to be returned as it may either be too far up on the inner harbour system, or in too deep water within Bream Bay. Even in the present-day situation this is likely to require inspection of the channel and inlet to confirm the safe operability of vessels accessing the port and jetty and it is likely that some maintenance dredging may be required to maintain operability.

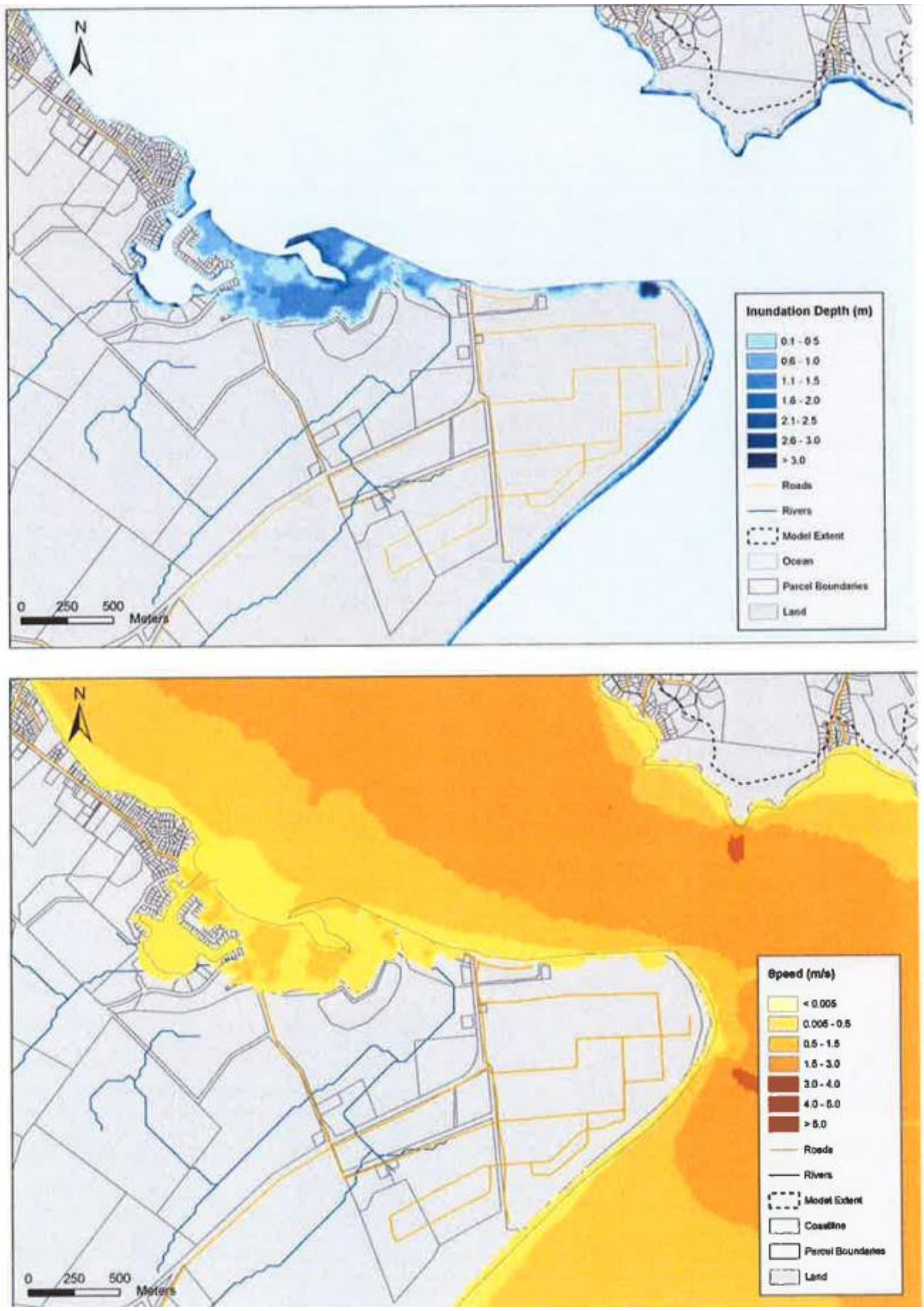


Figure 3-21: Maximum inundation depth (upper) and speed (lower) for the South American tsunami scenario at MHWS (Source: Arnold et al. 2011)

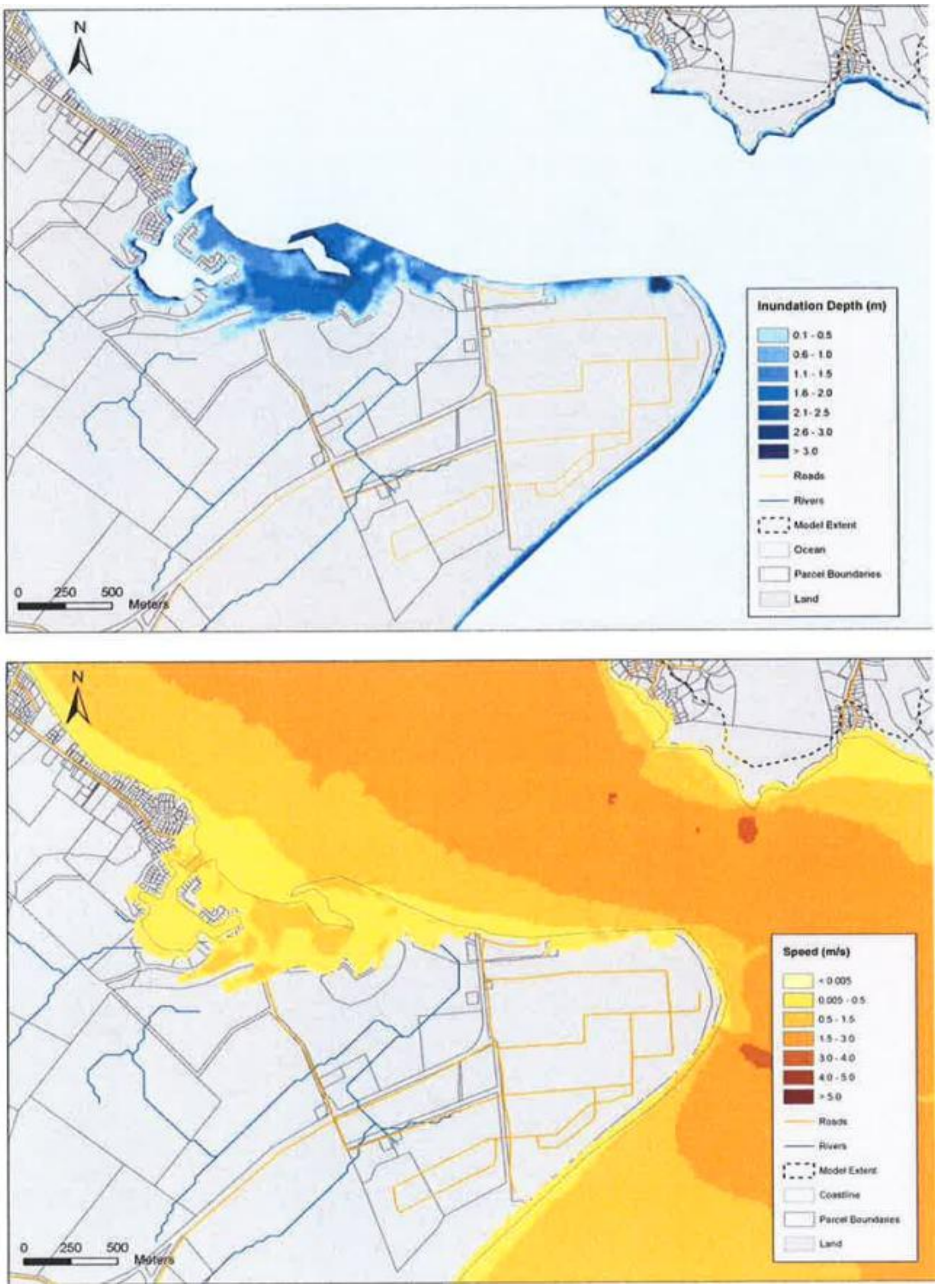


Figure 3-22: Maximum inundation depth (upper) and speed (lower) for the South American tsunami scenario at MHWS + 0.5 m Sea Level Rise (Source: Arnold et al., 2011)

3.11 Climate change effects

Climate change effects include changes to sea level and potential effects on storms, wind, storm-tide and wind. We address each in turn.

3.11.1 Sea level rise

Historic sea level rise in New Zealand has averaged 1.81 ± 0.05 mm/year from around 1900 to the present, with the rate doubling to 2.44 mm/year for the period 1961 to 2018 compared to data from

1900 to 1960 (Bell, 2019). The more recent rate is like the Marsden Point data that exhibited a rate of 2.2 ± 0.6 mm/year.

IPCC has produced the latest climate change projections (IPCC AR6, 2023). This has been downscaled by NIWA ([NZ SeaRise Programme](#)). The new assessment includes five emission scenarios with the 2.6, 4.5 and 8.5 scenarios that are similar, but not the same, as the AR5 report. Figure 3-23 shows the projected sea level rise for these scenarios (solid lines showing medium projections) with the shaded areas showing the bounds of uncertainty (i.e. 83rd and 17th percentiles) and Table 3-6 shows the median projections from 2005 to 2150.

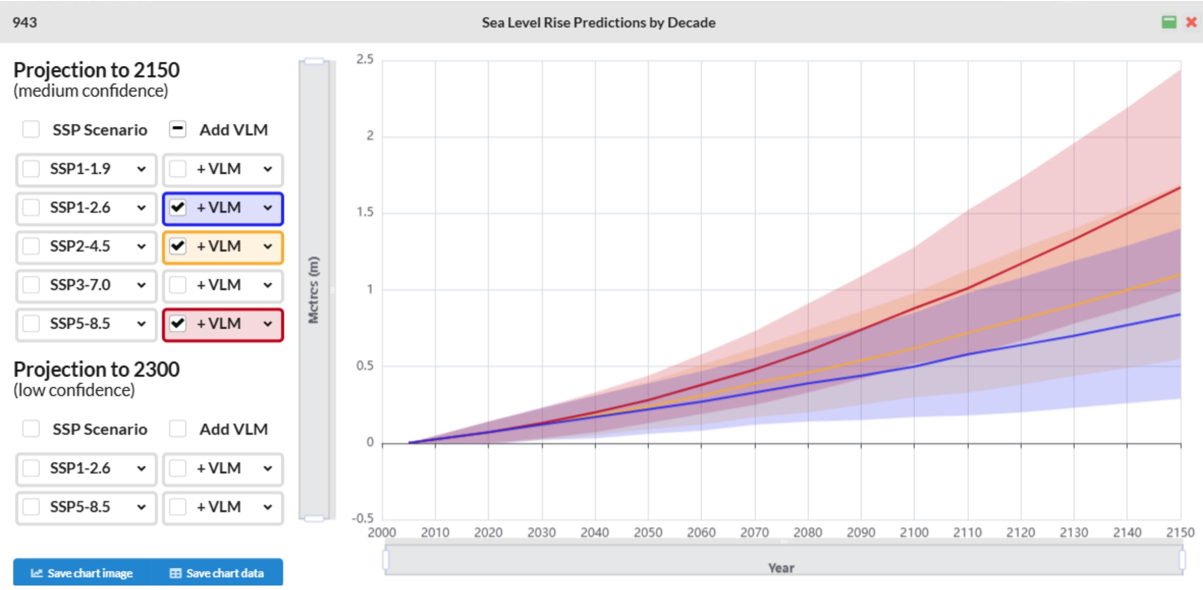


Figure 3-23: Projection sea level rise, including vertical land movement and uncertainty for three SSP scenarios (Source: [NZ SeaRise Programme](#))

Table 3-6: Projected relative sea level rise values (including VLM)

Year	SSP1-2.6 + VLM	SSP2-4.5 + VLM	SSP5-8.5 + VLM
2005	0	0	0
2020	0.07	0.07	0.07
2030	0.12	0.12	0.13
2040	0.17	0.18	0.2
2050	0.22	0.24	0.28
2060	0.27	0.31	0.38
2070	0.33	0.39	0.48
2080	0.39	0.46	0.6
2090	0.44	0.54	0.74
2100	0.5	0.62	0.88
2110	0.58	0.72	1.01
2120	0.64	0.81	1.17
2130	0.7	0.9	1.33
2140	0.77	1	1.5
2150	0.84	1.1	1.67

The modelling also includes the potential for a low likelihood, high consequence event of marine ice cliff instability (MICI), although this scenario is characterised by deep uncertainty due to limited process understanding and limited availability of evaluation data. If this event does occur, sea level changes could be in the order of 2 to 5m at 2150.

3.11.2 Climate change effects on storms, winds, storm tide and waves

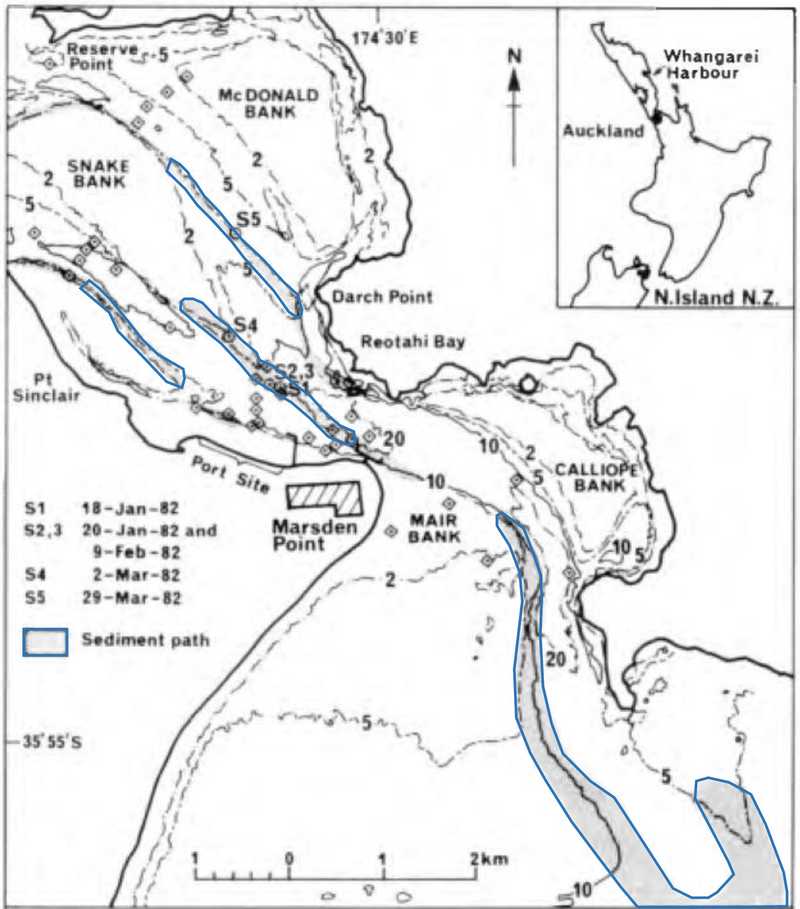
NIWA has investigated possible future changes to storm surge and wave climate around New Zealand for present day conditions and then with future scenarios of climate change based on the IPCC emission projections. The frequency of tropical cyclones is predicted to decrease slightly but could be more extreme (MfE, 2025), but the impact of cyclones can increase due to sea level rise. The results of NIWA's assessment suggest the northern New Zealand region would expect only small increases in mean annual wave height (generally less than 2 to 3%) with slight increases on the western and southern coasts, but small decreases in mean wave height elsewhere. For the extreme wave height increases of between 0 to 5% could be expected with a lower likelihood of increases up to 15%.

4 Coastal processes

4.1.1 Lower harbour stability

Stability of the harbour entrance has also been attributed to the presence of shell material, which provides an armour layer protecting the underlying soft sands. This was confirmed by Black and Healy (1982) who investigated sediment transport in Marsden Point and concluded the shell lag present on much of the inlet rarely moves, even in spring tide conditions, and that much of the bed have an aged appearance with the shells being covered by algae; a testimony to the stability of the sediment and the low rates of sand supply by alongshore drift. Kench and Ford (2011) and Kerr and Associates (2016) also identify the role of shells in the long-term stability of the ebb tide delta and Mair Bank.

The Black and Healy study (1982) defined that no sediment movement occurred when tidal velocities were less than 0.3 m/s and that sand grains were moving more than 50% of the time when current speed at 1m above the seabed was between 0.3 and 0.35 m/s. The main sediment transport paths due to tidal currents are identified in Figure 4-1.



Location of Whangarei Harbour, North Island, New Zealand and the field measurement sites. Active sediment transport paths are shaded.

Figure 4-1: Main sediment transport paths due to tidal currents (source: Black & Healy, 1982)

MSL (2016b) sediment dynamic modelling shows very similar sediment transport pathways to those identified by Black and Healy (see Figure 4-2).

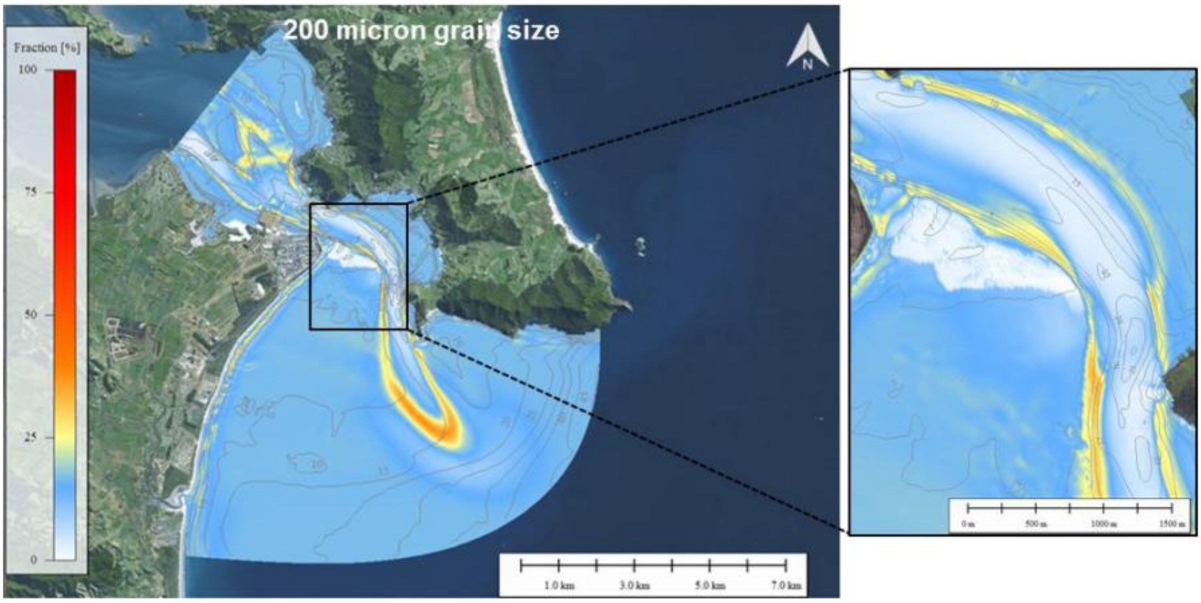


Figure 4-2: Distribution of 200 µm grain size sediments for a 6-month fair weather period (Source: MSL, 2016b)

The lower harbour sediment dynamics are consistent with established patterns for tide-dominated inlets, with separation of the channel into areas of ebb and flood dominance, and typical transport patterns over the flood tidal delta. Broad-scale inlet geomorphology has been maintained, which is consistent with other dredged tide dominated inlets (Longdill and Healy, 2007). Concentrations of shell gravel lag were found to play an important stabilising role in determining the overall characteristics of the inlet stability and sediment dynamics (Longdill and Healy, 2007).

The comparisons of bathymetric surveys carried out by Healy and Longdill (2007) revealed that the lower harbour is very stable with essentially no change to bathymetry in many areas over a 20-year interval. Recorded tidal flows were found to be faster than the threshold speed for typical sandy sediments, but insufficient to disturb lagged shell beds (Black et al., 1989). Previous studies suggest that suspended sediment transport in the lower harbour is low and that the majority of sediment transport in the channels and channel margins occurs as bed load (Longdill and Healy 2007).

Residual distance vectors computed by Longdill and Healy (2007) in the lower harbour indicate that between 2002 and 2007 (i.e. post Northport developments), the large-scale pattern of sediment transport dynamics remained consistent. Minor and localised modification of transport potentials were observed immediately adjacent to the Northport developments. These modifications included a slight realignment of current flows near the reclamation wall and some leakage from a previously identified transport loop near the dredged basin. The potential for scour was identified by Longdill and Healy (2007) along the eastern margin of the dredged basin, and they suggested this could remove material moving downslope into the basin from its western edge. The observations were considered to be consistent with the earlier numerical model results that predicted minimal consequences resulting from the developments (Black and Healy, 1982). Since there has not been significant changes to the bathymetry since that time, the findings from the earlier studies are still valid.

Sediment transport pathways were inferred by Black et al. (1989) from observations and numerical modelling (refer Figure 4-3). According to their results, there is a net ebb imbalance in the lower harbour southern end, and they suggested that deposition as a result of the Northport developments should be minimal, which is in general agreement with the modelling carried out by MSL (2016b).

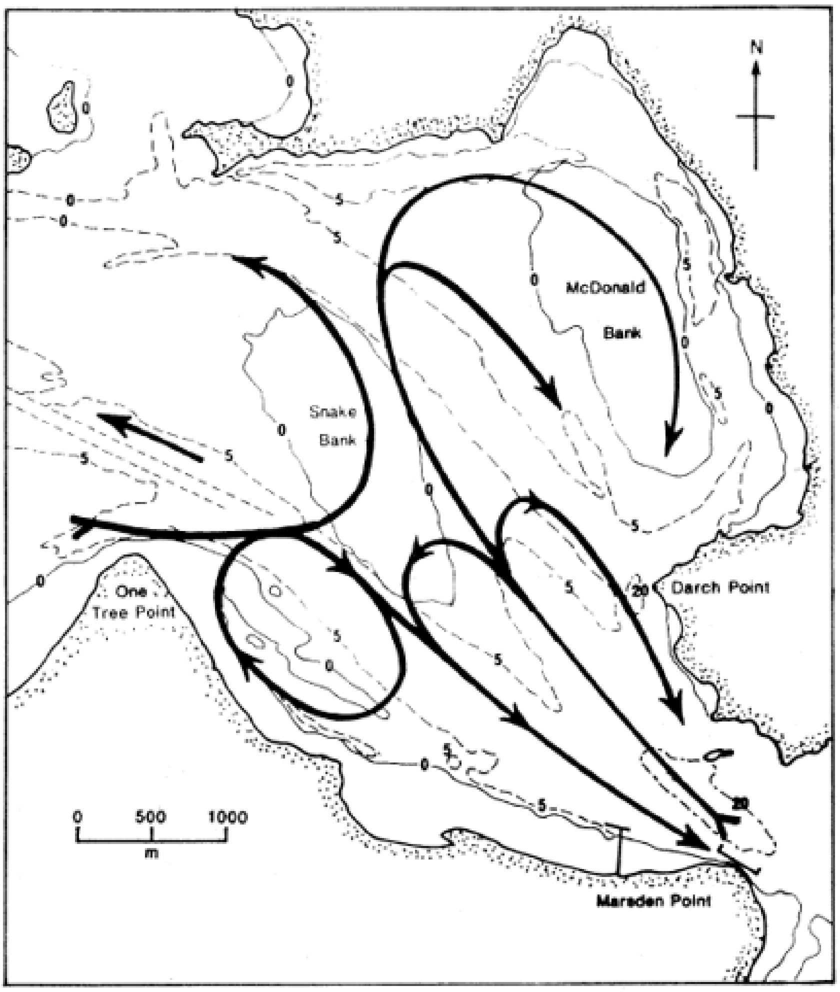


Figure 4-3: Schematic diagram showing sediment transport pathways within Whangārei Harbour based on residual velocities (Source: Black et al., 1989)

4.1 Sediment transport trends within Marsden Bay

Sediment transport trends in Marsden Bay are informed by the frequency and quantity of sediment dredged from the access channel to Marsden Cove Marina.

Based on data received from Marden Cove Ltd, a small amount of dredging took place in 2010 along the eastern edge of the outer channel (no volume specified). Marsden Cove entrance channel was also dredged in 2014 and 2018 with some 2,000 m^3 of sand dredged. Surveys taken for the 2018 campaign show sediment build up on the western side of the channel (see Figure 4-4), and a small buildup of material at the subtidal confluence was also observed (DML, 2018), reportedly in a similar location to the 2010 build-up. The dredged sand was deposited on the beach at the eastern side of the training groyne. General dredging of 1,100 m^3 and around 1,350 m^3 was also carried out along the floor of the entrance channel in May 2023 and May 2025 (location of dredging not specified).

The volume of maintenance dredging is relatively small and the infill on the western side of the channel indicated wind wave driven transport from the intertidal flats along the western side of the channel. The eastern infill is largely at the entrance to the channel where flood tidal flows extend along the existing natural channel and at the outlet of Blacksmiths Creek stream channel.

This suggests a low energy environment, dominated by infrequent higher energy wind generated waves at high tide from the dominant NW fetch and to a lesser degree discharges from the Creek and flood tide flows.

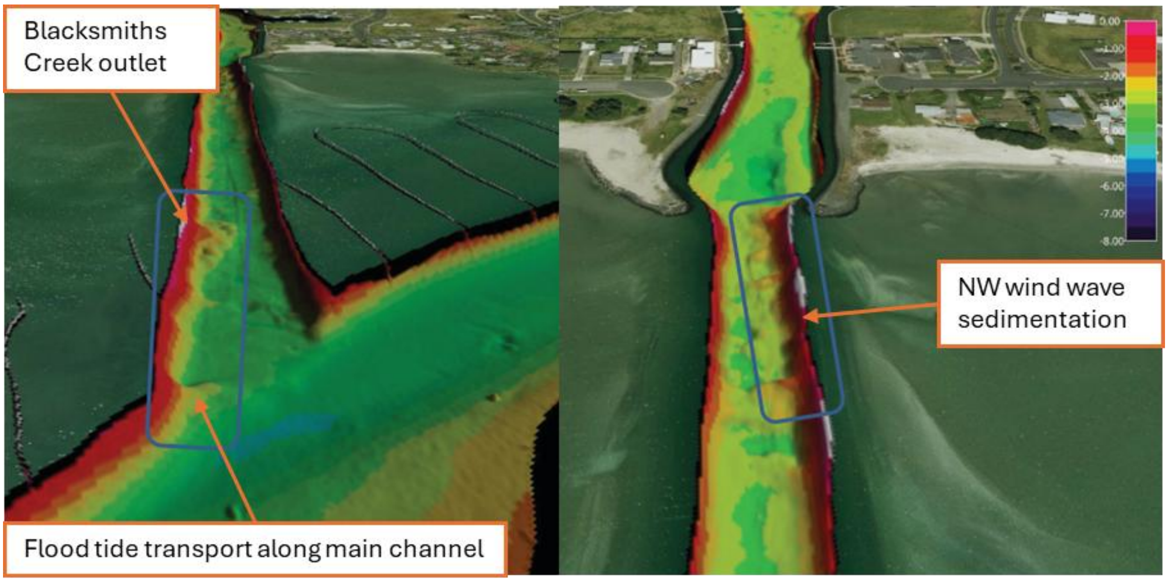


Figure 4-4: Locations of sedimentation of the access channel to Marsden Cove Marina

4.2 Summary of coastal processes

The Whangārei Harbour entrance and the lower harbour area is dynamically stable, controlled by Whangārei Heads to the north and the large ebb delta to the south. The northward directed net longshore sediment transport on the open coast of Bream Bay is very small in comparison with the sediment flux that enters and exits the harbour because of tidal exchange. Therefore, the inlet is tide dominated, with tidal flows significantly greater than the net littoral transport which results in a stable inlet.

Sediment transport trends in Marsden Bay are low due to the low wave energy environment, dominated by infrequent higher energy wind generated waves at high tide from the dominant NW fetch and to a lesser degree discharges from the Creek and flood tide flows.

Ongoing and accelerated sea level rise may result in increased wave heights acting within Marsden Bay due to the greater water depth, which is likely to result in erosion of the upper beach systems, with sediment transported to the intertidal shelf and then transported towards the east due to the dominant wind wave direction along the main harbour channel to the north west.

5 Assessment of effects of changes in physical coastal processes

Effects have been assessed based against the criteria set out in Appendix A that describes the definition of effects and the associated criteria. This table was developed by T+T informed by the Ecological Impact Assessment (EcIA) guidelines (Roper-Lindsay et al., 2019) which is widely adopted to support resource consent applications.

5.1 Scenarios considered

The coastal effects at this location are largely driven by changes to hydrodynamics which have been modelled by MOS (2026a). This includes the existing channel configuration with the shipyard and stage one dredging and the present port configuration as well as with the consented but as yet unconstructed eastern reclamation with the stage two dredging. These scenarios were then tested using morphodynamic modelling (MOS, 2026b) and the dredge sediment plume dispersion (MOS< 2026c).

Previous modelling by MOS (2020b) which included the CINZ channel deepening identified that the channel deepening will not change the results of the assessment, and this scenario has not been modelled further.

5.1 Construction effects of the reclamation and dredging

Construction elements within and adjacent to the CMA are the forming of the reclamations and the seawalls that protect them, as well as the dredging to locally deepen part of the port area. The general approach to construction is set out in the Construction Methodology memo (Beca, 2026).

The construction will require the following components:

- Dredging of the turning circle including the berthing area and the lift device pocket and potentially the western perimeter berthing face.
- Reclamation of seabed for hardstand and facilities, contained by a combination of piled quay walls and sloped rock revetments
- An open piled finger wharf structure for berthing on the northern face.

5.1.1 Dredging

The main effect from dredging is the dispersion of fines from the dredging process, which can affect water clarity, impact the ecology particularly as there is good water clarity as evidenced by low suspended solids (refer Figure 3-14). From a coastal process perspective, the dredging process could result in an accumulation of sediment as the suspended sediment settles out in other parts of the harbour that could change tidal flows and the movement of sediment.

As described in Section 3.6, dredging is within the interbedded layers of fine to medium sand layers and clayey sands. There is no dredging in bedrock that is situated well below the base of the basin. Based on an analysis of sediment chemistry from previous investigations the dredged sediment is clean with contaminant levels either below detection or within the lower range of acceptable guidance criteria (Coffey, 2016).

The dispersion of sediment plumes associated with the proposed dredging has been carried out by MOS (2026c) and this assessment relies to the modelling presented in their report, which considers plume generation at different locations of the dredge footprint for a range of dredging methods including a Backhoe Dredge (BHD), Cutter Suction Dredge (CSD) and a Trailer Section Hopper Dredge (TSHD), as it is likely that a combination of dredge methods could be used.

MOS (2026c) considered the effects of both a silty sand and a sandy silt that could be encountered and provided assessment of 50th and 90th percentile suspended sediment concentrations at the surface, mid-water and near bed levels for the three dredging methods for both sediment classes with the existing bathymetry and with the modified bathymetry.

The modelling with the existing situation represents the initial dredging phase, before the seabed is deepened. Based on the geotechnical information summarised in Section 3.6, the silty sand scenarios are more likely to represent these initial conditions. However, with depth, there will be a period where the sandy silt results for the proposed NSDF bathymetry may be more representative.

With the BHD likely to only be used in more confined areas, the greatest plume extents appear to occur for the TSHD and the following figures use the MOS (2026b) results for this scenario. Figure 5-1 shows the silt plume concentration for sandy silt with the existing bathymetry, with row [A] showing the surface, mid depth and near bed 50th percentile total suspended sediment distribution for the TSHD Dredge and Row [B] the 90th percentile distribution. Figure 5-2 shows the same scenario, but for sandy silt with the proposed bathymetry for the eastern reclamation and the NSDF. The results show that half the discharges (i.e. the 50th percentile) remain within the dredged area, although the 90th percentile plots show some of the sediment plume extending both west and east along the main channel. This suggests that there is the potential for some sediment deposition within the main channel to the east and west. The potential sediment deposition depth, including an allowance of bulking factors is shown in Figure 5-3 for both the existing bathymetry and with the eastern reclamation and NSDF bathymetry.

Figure 5-3 shows the largest potential for deposition occurs largely within the existing and proposed port and dredged areas for the Shipyard Project, and deposition within the dredged area will be removed to achieve the required dredge depth. Initially there is also a likelihood of deposition occurring within the main channel to the west although this is likely to reduce as dredge depths increase as shown comparing the results of the two different bathymetries. is also likely to be redistributed back into the dredged area and the overall port dredge area, either during the capital works dredging, or over time, as the peak tidal currents are in the order of 0.5 m/s (see Figure 3-17) which are sufficient to mobilise sediment deposited in the channel. Sediment that returns to the dredged area will settle out requiring it to be removed by ongoing maintenance dredging.

Relating the modelling with observations from previous dredging campaigns suggests the modelling showing the 90th percentile extents may result in a conservative (upper bound) of potential effects. 4Sight Consulting, who made observations from previous dredging campaigns including the original port construction and maintenance dredging carried out in 2018, reported significantly lower values of suspended solids than predicted by the numerical modelling (4Sight, 2021). Monitoring should be included in the construction environment management plan (CEMP) to determine the actual level of plume extent and concentration, and any required monitoring and mitigation. Mitigation for the potential risk could include sediment curtains around the dredge vessel, or timing limited to periods of low tidal flows, if required.

Construction effects on physical coastal processes outside the proposed area for dredging is considered minor.

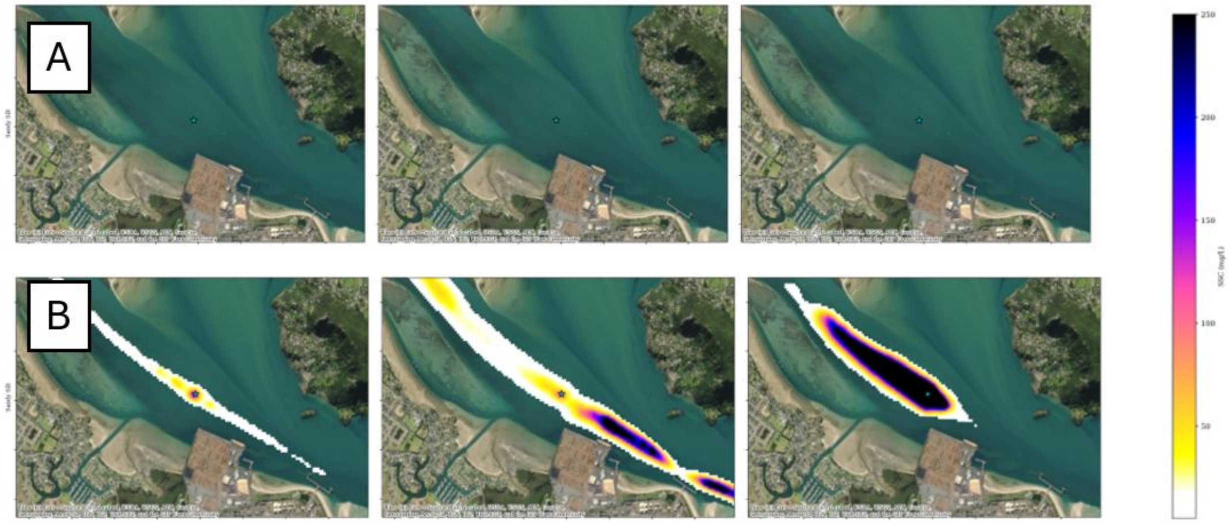


Figure 5-1: Silt plume concentration for silty sand at site 1 with the existing bathymetry, Row [A] represents the surface, mid depth and near bed 50th percentile total suspended sediment distribution for the Trailer Suction Hopper Dredge and Row [B] shows the 90th percentile distribution (Modified from MOS, 2026c)

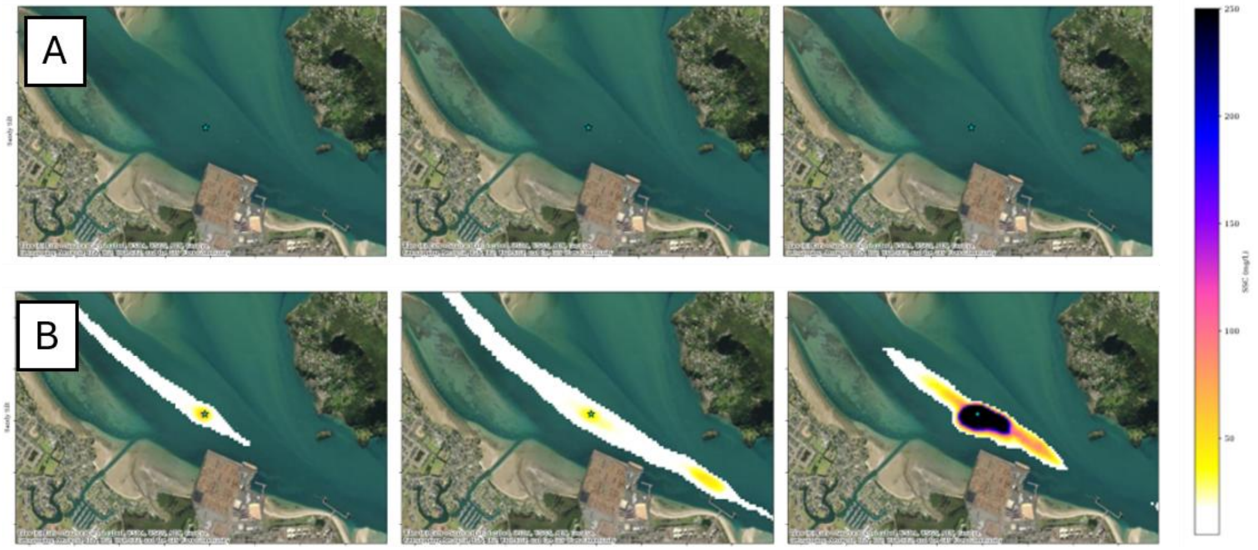


Figure 5-2: Silt plume concentration for silty sand with the proposed Eastern Reclamation and NSDF bathymetry, Row [A] represents the surface, mid depth and near bed 50th percentile total suspended sediment distribution for the Trailer Suction Hopper Dredge and Row [B] shows the 90th percentile distribution (Modified from MOS, 2026c)

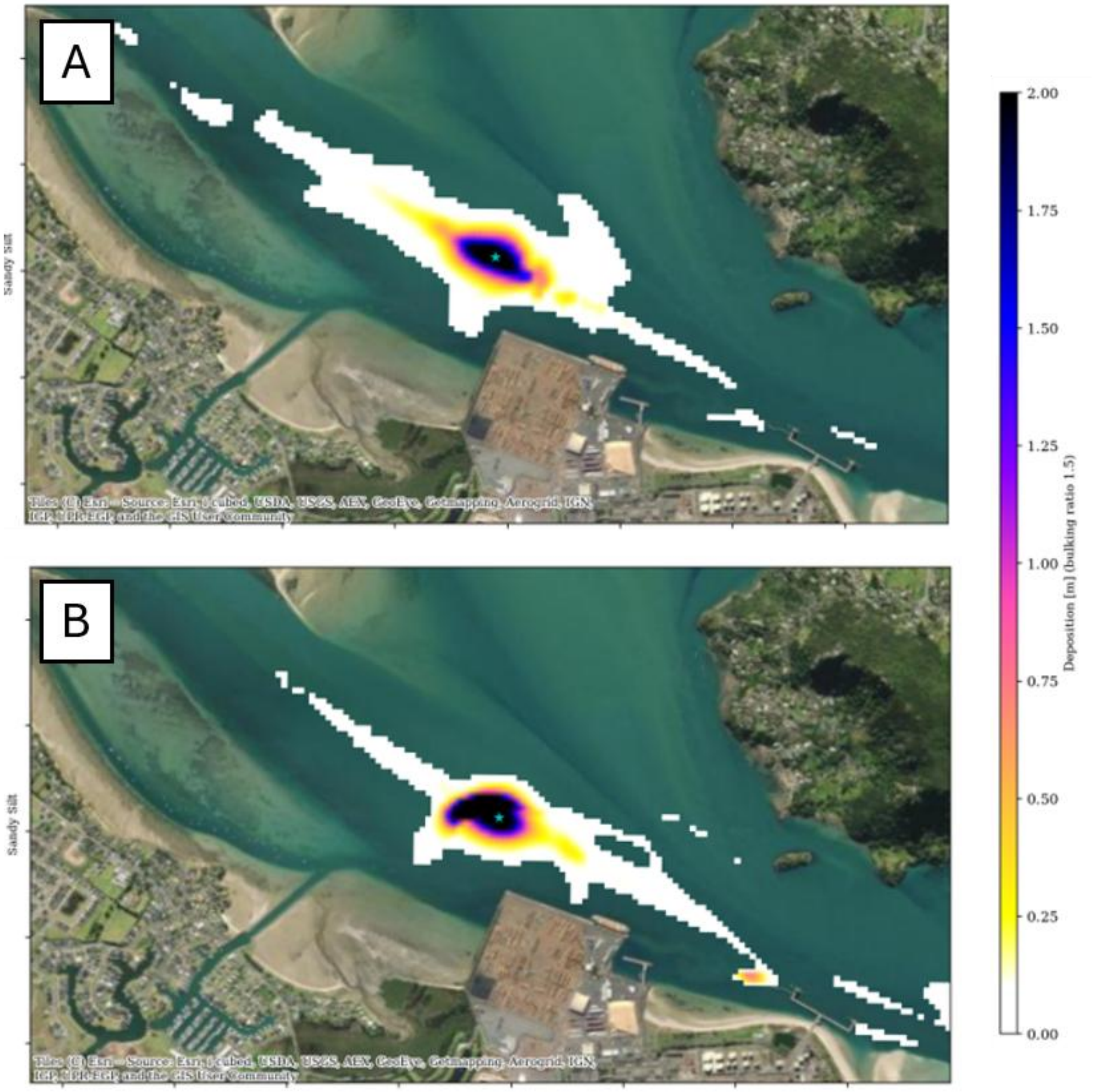


Figure 5-3: Cumulative sediment deposition thickness (m) for TSHD dredge with the existing bathymetry [A] and the proposed Eastern Reclamation and NSDF bathymetry [B] for sandy silt (Source: MOS, 2026c)

5.1.2 Reclamation

The reclamation will have two forms of containment structures; a rock revetment and a piled structure. The rock revetment will typically be constructed from landside and be formed by the end tipping of locally quarried rock core material with an outer perimeter rock armour protection. As this structure reaches the deeper water an element of the structure may be constructed using marine split hopper barges to place larger quantities of material on the base and avoid road haulage. The inner face of this structure would typically be lined with a geofabric to contain the fill placed during the dredge and reclaim phase (Beca, 2026).

The remainder of the reclamation containment will likely be formed by the installation of an 'Anchored Combi-Wall' type structure which would essentially be constructed of a steel tube and sheet piled front wall with steel tie rods running back through the reclamation to a rear sheet piled anchor wall. It is anticipated that piling work will be undertaken from marine plant and as the materials are generally non cohesive the piles would be installed using Vibro Hammer techniques with a small percentage of the piles being hammered to for final driving in order to determine their load capacity (Beca, 2026).

The potential effects of construction of these components are the occupation of the seabed and the increase in suspended sediment plumes during the construction of the seawalls. Provided the rocks used for seawalls are relatively free from dirt and contaminants the likelihood of any significant sediment plume extending beyond the extent of the shipyard and drydock area is low.

The filling of the dredged area is likely to be done with sediment dredged from the turning basin and berthing areas. The effect of dewatering from the sediment has been modelled by MOS (2026c). The most significant extent of discharge occurs for sandy silts at the near bed, and this condition is shown in Figure 5-4. The results show that the discharges are significantly smaller than the dredging and largely confined to the near bed layer and within the port and Shipyard dredged area.

Construction effects on physical coastal processes outside the proposed reclamation and seawall area is considered negligible.

Figure 5-4: Total suspended sediment concentration for reclamation dewatering for silty sand at the near bed (Source: MOS, 2026c)

5.2 Long term effects of the shipyard reclamation

Long term effects on the shipyard could occur if there are significant changes to the tidal flows within the lower harbour.

5.2.1 Currents

Changes in velocity have been modelled by MOS (2026a) with information presented at discrete points around the lower harbour as well as plan view changes in velocity that compare the existing and the two development scenarios. The location points where current speed has been extracted is shown in Figure 5-5 and the plot showing the resulting change in spring tide velocities is shown in

Figure 5-6**Error! Reference source not found.**. The comparison of plan-view tidal velocity changes with and without the proposed development including the stage one dredging during peak flood and ebb tides for springs and neap tide conditions are shown on Figure 5-7. This figure removes small scale velocities (i.e., between -0.01 m/s and +0.01 m/s) to allow focus on the larger velocities that may have more significant consequences.

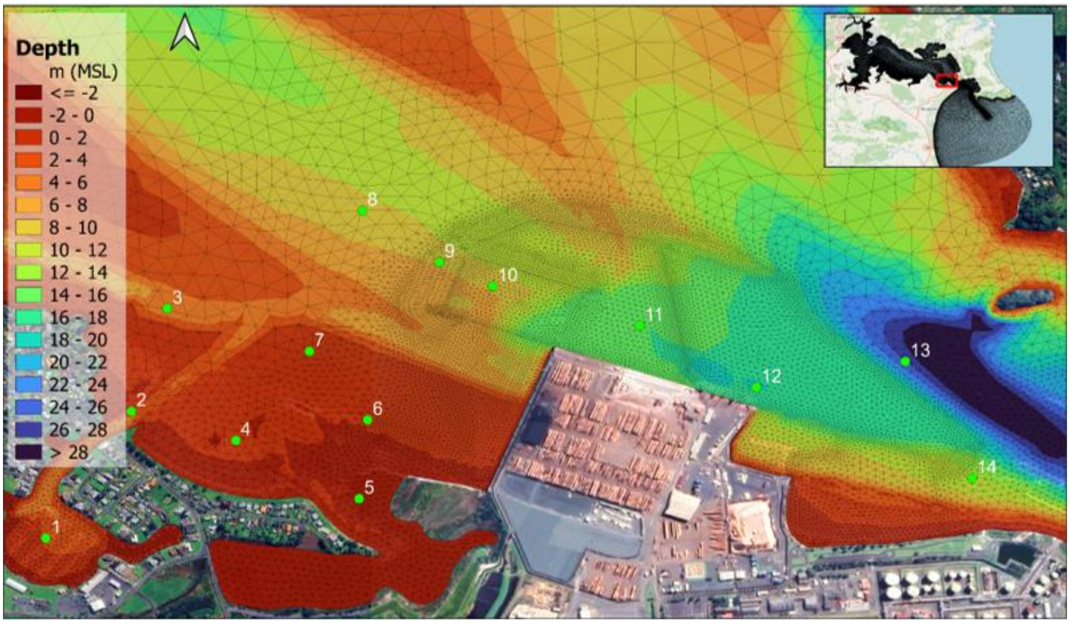


Figure 5-5: Location of output points (Source: MOS, 2026a)

For the shipyard development with stage 1 dredging (*Figure 5-6***Error! Reference source not found.**[A] and Figure 5-7), the results show slight lowering of velocities in and adjacent to the dredged area for both peak ebb and flood tides. During ebb spring tides there appears to be a focussing of tidal flows within the dredged channel and along the channel axis, with lowering of currents along the adjacent seabed and locally higher currents immediately adjacent to the Northport berthage. Due to lower velocities during neaps, extent of the changes is over a smaller area. Within Marsden Bay velocities are generally lower or show no change. Location Point 1 (Figure 5-6**Error! Reference source not found.**[A] within Marsden Cove Marina) and Location Point 5 (entrance to Blacksmiths Creek) shows no change. Within the eastern side of Marsden Bay (Location Points 4 and 6) there is a reduction in peak velocities to around 0.2 m/s and along the channels adjacent to Marsden Bay (Location Points 2 and 7) there is slight shifts in the velocity but only minor changes. Over Snake Bank there are slight increases in velocity both during peak ebb and peak flood tides but examining Output Point 8 (Figure 5-6**Error! Reference source not found.**[A]) changes are very small increases in velocity for both flood and ebb. In all cases, velocity changes are in the order of ±0.1 m/s or less except along the northern face of the Northport reclamation, where peak velocity changes are closer to 0.3m/s.

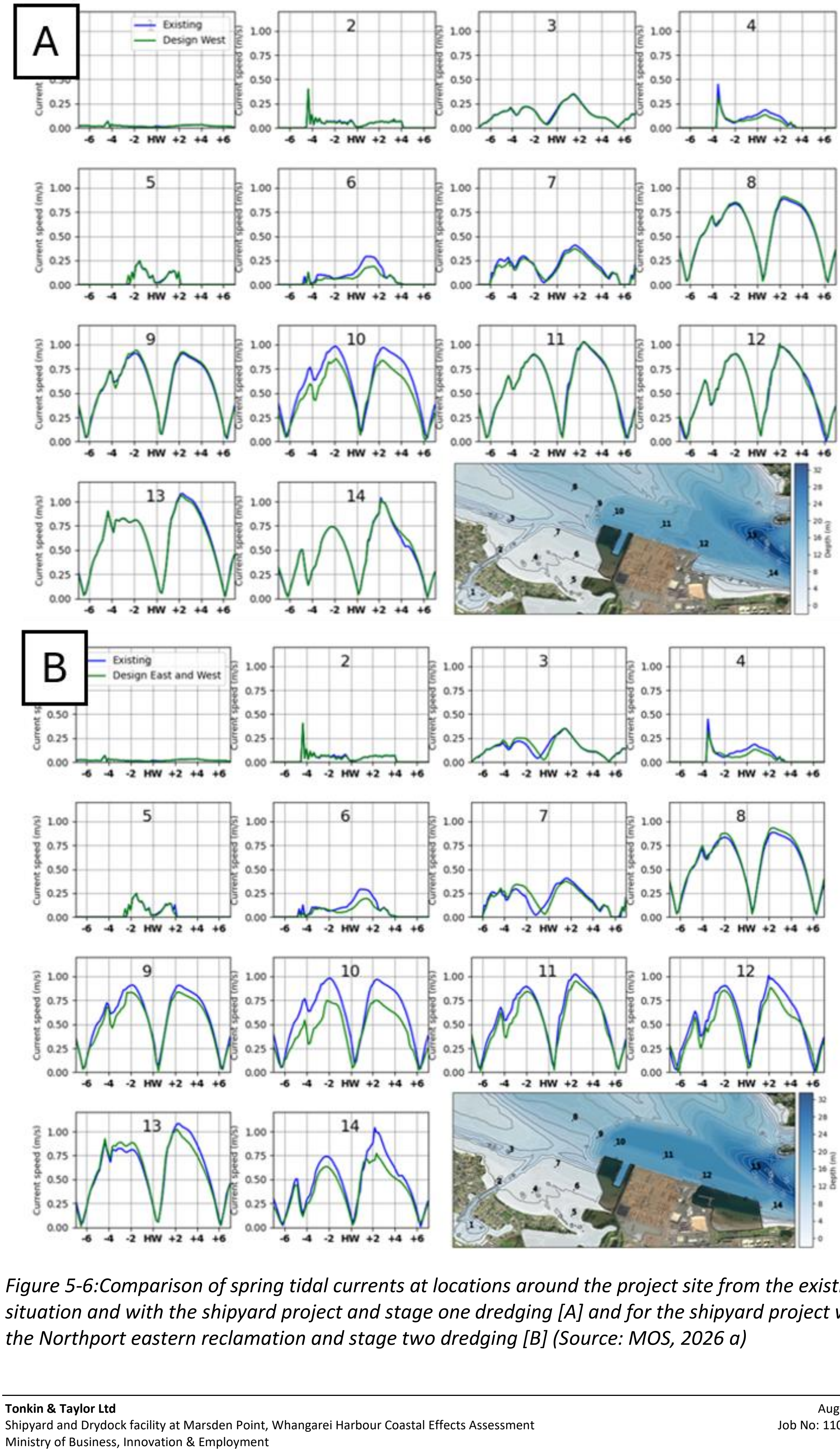


Figure 5-6:Comparison of spring tidal currents at locations around the project site from the existing situation and with the shipyard project and stage one dredging [A] and for the shipyard project with the Northport eastern reclamation and stage two dredging [B] (Source: MOS, 2026 a)

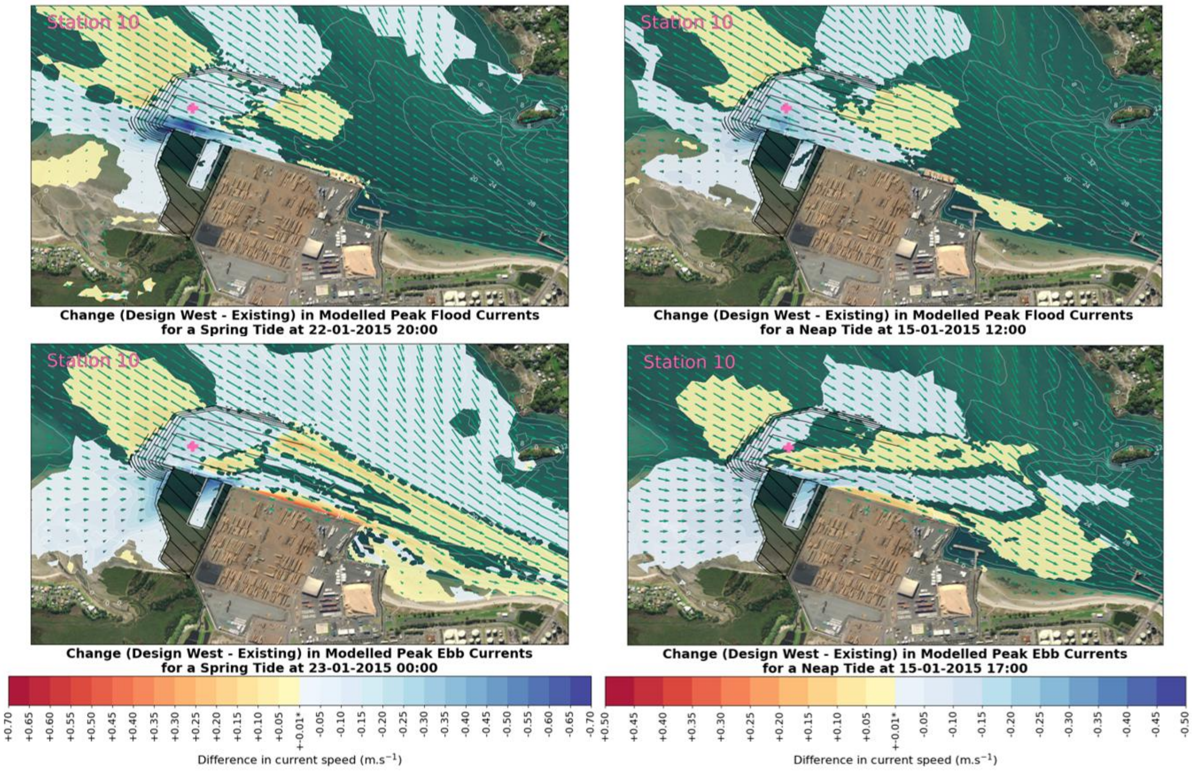


Figure 5-7: Difference in peak tidal currents during spring (LHS) and neap tides (RHS) with the proposed shipyard reclamation and stage one dredging for peak flood (top) and ebb (bottom) (Source: MOS, 2026a)

Changes in tidal velocities with and without the proposed shipyard development, inclusive of the Northport eastern reclamation and stage two dredging are shown in Figure 5-8 **Error! Reference source not found.** for peak spring and neap tide conditions and at output points for spring tide in Figure 5-6**Error! Reference source not found.**[B]. Trends in current changes are similar to the stage 1 dredging, but due to the larger extent of dredging there is a larger zone of reduced peak currents. Immediately adjacent to the Shipyard reclamation the reduction in tidal currents approaches 0.3 m/s and there are only slight increases in tidal currents along the NorthPort reclamation face compared to the stage one dredging case. The trend of increased currents along the axis of the channel to the west along Snake Bank (Location Points 8, Figure 5-6[B]) and to the east is evident. The higher flood and ebb velocities over Snake Bank are proportionally relatively small (i.e. changes of around 0.1 m/s for a velocity of around 0.8 m/s). However, this is likely to create increased movement of sediment both to the east and west.

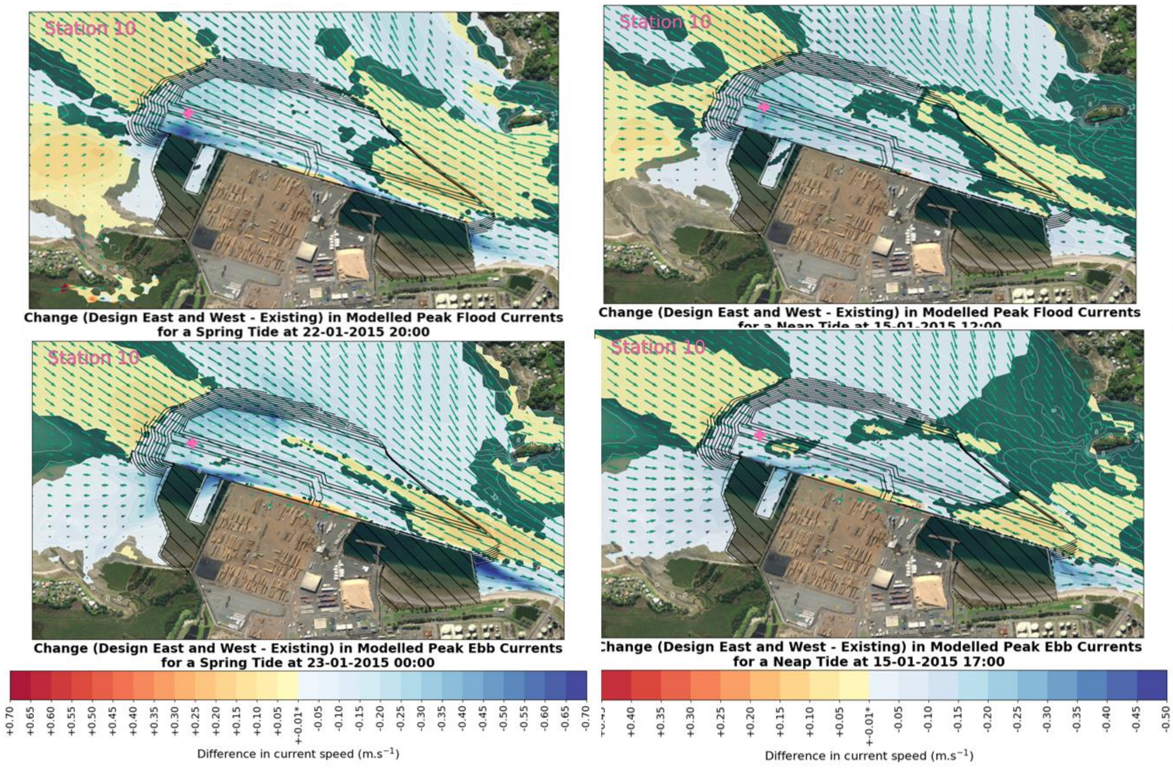


Figure 5-8: Difference in peak tidal currents during spring (LHS) and neap tides (RHS) with the proposed shipyard reclamation, stage two dredging and Northport reclamations for peak flood (top) and ebb (bottom) (Source: MOS, 2026a)

Both development scenarios showed similar trends, with only relatively small changes in velocities at some locations as can be seen in Figure 5-6**Error! Reference source not found.** for spring tide conditions. Where there are changes between the shipyard project with and without the eastern reclamation, they are relatively small (i.e. less than 0.1 m/s). Similarly for neap tide conditions there are similar changes in velocity, but overall lower velocities than occur during spring tides. These relatively small changes in tidal current will have no significant change in effects from a coastal process perspective, so we will not report on effects for both scenarios.

No significant change in tidal velocities outside the dredged areas for the shipyard and port areas suggest no significant changes in coastal process is likely to occur within the lower harbour or tidal inlet and therefore no wider effects beyond these locations.

The morphological response to these changes in current have also been modelled by MOS (2026b) for the existing situation and with the proposed shipyard and the resulting changes are shown in Figure 5-9 over a one-year and 5-year period. The results show no significant changes within Marsden Bay or the lower harbour area, some slight sedimentation on the dredged side slopes to the west of the dredged area that will periodically require some maintenance dredging. There is no additional deposition in the Northport dredged area from the shipyard dredging and reclamation.

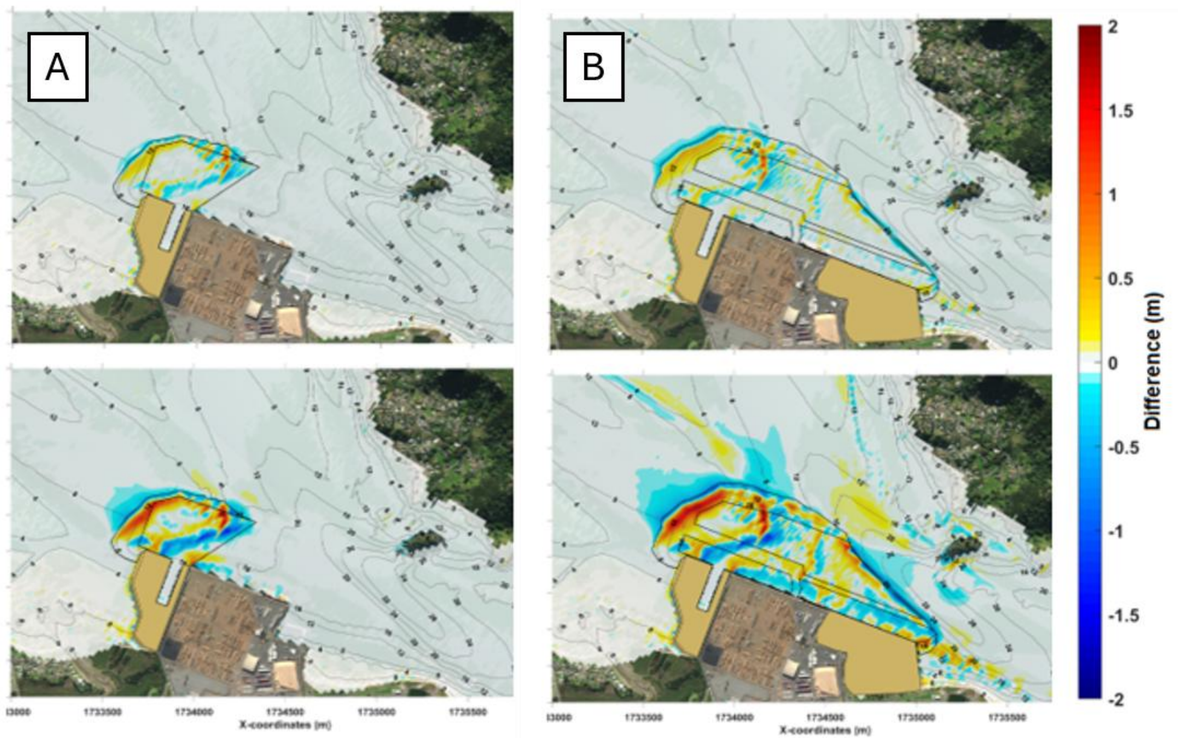


Figure 5-9: Predicted difference plot of sedimentation changes from the existing for proposed shipyard development (left had side) and the shipyard and eastern reclamation for a 1 year (top row) and a 5-year period (bottom row) (Source: MOS, 2026b)

Based on the morphological response, **the long-term effects of the proposal on currents and associated sediment transport are assessed to be minor within Marsden Bay and the harbour seabed to the west of the dredged area.**

5.2.2 Water level

Possible changes to water levels were also examined by MOS (2026a) at Location Point 3 (the channel adjacent to Marsden Bay) and Location Point 10 (in the dredged area off the Shipyard reclamation (refer **Error! Reference source not found.** for locations). For both development scenarios, no changes were observed at Location Point 3 and there was a 0.01 m increase in the predicted highest astronomic tide (HAT) with the dredged footprint but no other change to the other tidal planes such as Mean High Water Springs (MHWS) or Mean Sea Level (MSL). This suggests that there will be no measurable change to the water levels within the harbour. **The effect of changes to water level are considered to be negligible.**

5.2.3 Wave driven changes within Marsden Bay

This section summarises the changes to waves in the nearshore environment within Marsden Bay resulting from the proposed reclamation which is occupying the north-eastern corner of the embayment. Our assessment is informed by the hydrodynamic and morphological modelling carried out by MOS (2026, 2022 and 2018). The key changes from a wave perspective is a sheltering of wind driven waves during high tide levels from the shorter north-eastern fetch (around 1.5 km) from across the harbour, which may to create a slight change increasing the dominance from the stronger north westerly waves that come from the longer fetch (around 12 km) along the main channel to the north-west. The main changes are likely to be:

- A small loss in beach area at the root (landward) end of the spit due to the reclamation occupation

- A slight reorientation of the exiting spit due to the small change in net wave energy
- Sedimentation of the intertidal area and mangrove occupation in the lee of the reclamation due to reduced wave activity

An overall summary of the expected changes is shown in Figure 5-10 and are discussed in more detail in the subsequent sections.

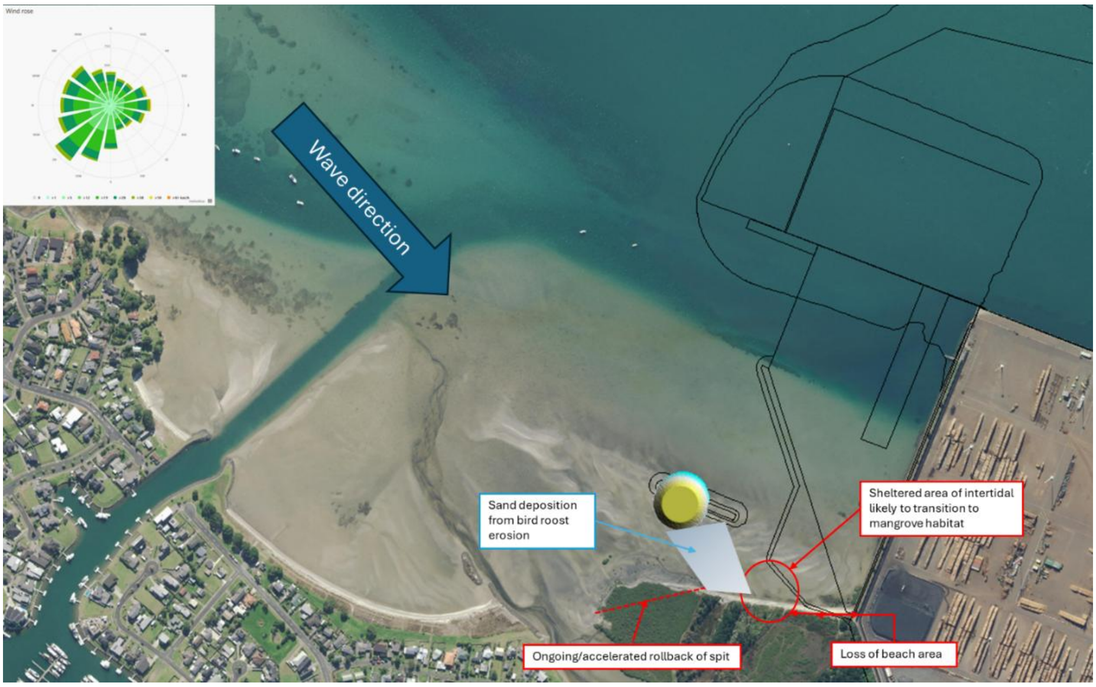


Figure 5-10: Summary of main changes to coastal processes resulting from proposed development

5.2.3.1 Occupation

The proposed reclamation will permanently occupy about around 9.7 ha with the majority within the coastal marine area below MHWS and around 550 m^2 at the eastern end of the Blacksmiths Creek spit that is above MHWS. The reclamation occupies around 2 ha of the intertidal area with the remainder being subtidal. It will change all these areas from sea to land and therefore coastal process within this occupation footprint will not occur.

5.2.3.2 Intertidal and subaerial sediment transport processes

The proposed shipyard reclamation extends westward of Northport within Marsden Bay therefore has limited additional effects to waves that may propagate into the harbour from Bream Bay. The shape of the reclamation means it is likely to increase the sheltering of wave energy at the very eastern end of the bay particularly from wind generated waves from the northern to north easterly sectors. This sheltering is likely to favour increased mangrove growth in the southeastern corner of Marsden Bay similar to what is already occurring to the west of the existing port reclamation (see Figure 5-11).

Figure 5-11: Accumulation of mangroves west of the present port reclamation

These reductions in wave heights due to more sheltering during high energy events has the potential to locally increase the rate of observed south easterly shoreline adjustment of the spit between the reclamation and Blacksmiths Creek (see Figure 3-7), with the main wave energy coming from the northwest along the largest fetch. However, sediment within Marsden Bay will remain within the bay (i.e. within the localised system). This potential change in net wave direction could slightly accelerate continue the observed change in shoreline angle of the spit and result in an acceleration of the rollback of the spit that is already occurring (see Figure 3-4 and Figure 3-5). **The effect of the proposed development on waves, sediment transport and shoreline change within Marsden Bay is minor.**

5.2.4 Expected changes to the inner harbour

The inner harbour area extends into Whangārei Harbour westward of Northport. Tidal flows are low and confined to the channels and waves tend to be locally generated within the harbour. The modelling shows no changes from the present west of Marsden Bay and Snake Bank. **The effects of the proposed development for the inner harbour are assessed to be nil.**

5.2.5 Expected changes to the ebb tide shoal and Mair Bank

No changes are expected to the ebb tide shoal and Mair Bank.

5.2.6 Expected changes to the open coast shoreline

No changes are expected along the open coast.

5.2.7 Expected effects on existing and future coastal hazards

The sandy shoreline along the Marsden Bay and within lower reaches Whangārei Harbour are currently susceptible to coastal erosion and are likely to experience greater erosion pressure as a result of sea level rise and climate change effects. The main driver for change will be increased sea levels that allow higher waves to reach the nearshore environment for all wave conditions. These changes are identified in the coastal erosion and coastal inundation hazard assessments by Northland Regional Council Coastal hazard assessment reports - Northland Regional Council.

With the results of the hydrodynamic modelling showing very little change to the hydrodynamics due to the proposed shipyard development, and hence very little change to sediment transport and the resulting coastal processes, the effects of the proposal on existing and future coastal hazards is negligible. The increased sea level will reduce the effect of the proposed dredging on wave processes (i.e., reduced effects from the present-day situation) as the greater water depth will reduce nearshore processes. The potential for increased tidal flow from the harbour will not be affected by the proposal as the throat of the inlet will not be modified and it is this area that controls the tidal flows. Apart from the occupation of the CMA and impact on the beach area, the proposal has a minor effect on tidal flows, wave energy and sediment transport in the present day. With increased sea level rise the effects of the proposed development is unlikely to significantly change. **The expected effects on existing and future coastal hazards are negligible.**

5.2.8 Tsunami

The existing harbour area is potentially exposed both to distant and local tsunami sources. The high velocities resulting from the tsunami are likely to result in large scale movements within the sandy systems of the nearshore, ebbtide delta, coastline and inner harbour. Specifically scouring of the narrower parts of the inlet throat with deposition both in deeper water seaward and landward of the inlet in the present-day situation. Even in the present-day situation this is likely to require inspection of the channel and inlet to confirm the safe operability of vessels accessing the port and jetty and it is likely that some maintenance dredging may be required to maintain operability. Tsunami wave modelling has not been carried out for this assessment, as the narrowest part of the inlet throat has not been modified and, the channel deepening is unlikely to change the large-scale effects of the tsunami on the wider environment. The location of the proposed development will also be sheltered by the Northport reclamation.

5.2.9 Overall long-term effects for the shipyard reclamation

The proposal is a reclamation to the immediate west of the existing Northport. The proposed development adds to the increased occupation of the CMA in this area and increases the spatial extent of effects on the seabed and shoreline due to the increased occupation. The effects on tidal currents and sediment transport within Marsden Bay is low and is also low for the wider harbour area. **Due to the minor changes to the currents and wave climate as a result of the shipyard reclamation the overall cumulative effect on coastal processes access is minor.**

6 National Policy Statement -Natural Hazards (NPS-NH)

While the NPS-NH doesn't specifically apply to infrastructure, we have provided a high-level assessment against the NPS-NH as a screening test against potential effects for coastal risks of erosion, inundation and tsunami.

6.1 Objective and framework of the NPS-NH

The objective of the NPS-NH is that "Natural hazard risk to people and property associated with subdivision use and development is managed using a risk-based proportionate approach".

The NPS-NH requires the level of risk associated with subdivision, use or development to be assessed using the risk matrix (*Figure 6-1*), with the assessment considering the potential impacts of climate change to at least 100 years into the future (Policy 6) using the best available information (Policy 5) and to be in accordance with Appendix 1 of the NPS.

		Likelihood Level						
		Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
	ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
	AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Consequence Level	Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
	Major	Very High	Very High	High	High	Medium	Medium	Medium
	Moderate	High	High	High	Medium	Medium	Low	Low
	Minor	Medium	Medium	Medium	Medium	Low	Low	Low
	Negligible	Low	Low	Low	Low	Low	Low	Low

Figure 6-1: Risk matrix set out in Policy 1 (Source: NPS- NH)

The likelihood of a natural hazard event occurring combined with the consequence of a natural hazard event for both life and property to determine the level of risk. The likelihoods are shown in Table 6-1 and the consequences in

Table 6-2.

Table 6-1 NPS-NH Likelihood table (Source: NPS-NH)

Likelihood level	Annual exceedance probability (AEP)	Average recurrence interval (ARI) or 'return period'
Almost Certain	10% or more	Up to and including 10 years
Very Likely	10% to 5%	Over 10 and up to and including 20 years
Likely	5% to 2%	Over 20 and up to and including 50 years
Possible	2% to 1%	Over 50 and up to and including 100 years
Unlikely	1% to 0.2%	Over 100 and up to and including 500 years
Rare	0.2% to 0.02%	Over 500 and up to and including 5,000 years
Very Rare	<0.02%	More than 5,000 years

Table 6-2: Consequence table (Source: NPS-NH)

Consequence level	Damage to property	Potential for injury or fatalities
Catastrophic	Severe damage to land and building(s), potential for collapse or total destruction of structures. Building(s) need to be demolished, rebuilt or relocated.	High threat to life safety, with probable fatalities and/or critical injuries.
Major	Major damage to land and building(s), including structural damage. Loss of use and substantial repair required.	Unsafe for people, with potential for many injuries, or critical injuries and/or fatalities.
Moderate	Some damage to land and non-structural damage to building(s). Limited loss of use, repairs required.	Unsafe for people, with potential for injuries, although expected to be minor.
Minor	Minor damage to land and building(s). No loss of use, minimal repairs required.	Isolated minor injuries possible.
Negligible	No loss of use, no building repairs required	No injury

Risks are graded from low, medium, high or very high with the risk frameworks shown in *Figure 6-1* , with a requirement to avoid very high natural risk and avoiding high or medium natural risk or mitigation proportionate to the level of risk, while ensuring creation or increasing natural risk on other sites is avoided or mitigated.

6.2 Assessment

Based on the effects assessment, the proposed development will only have a minor erosion effect to land within Marsden Bay due to slight sheltering and a small change in net wind wave energy and a negligible effect on water levels. The reclamation structure itself will be resistant to erosion for the next 50 years, and with maintenance, the next 100 years. The proposed deck level of the reclamation is 5 m CD. This equates to 3.22 m NZVD. Based on the extreme water levels set out in Table 3-3 and the projected relative sea level rise values in Table 3-6, the crest elevation will not be inundated in the next 100 years for either the SSP2-4.5 or the SSP5-8.5 median term projections. Similarly for tsunami effects, while rare are not expected to result in significant damage to the reclamation due to the sheltered location. Risks for the proposed development on both the existing environment and for the operability of the development are low (see Figure 6-2).

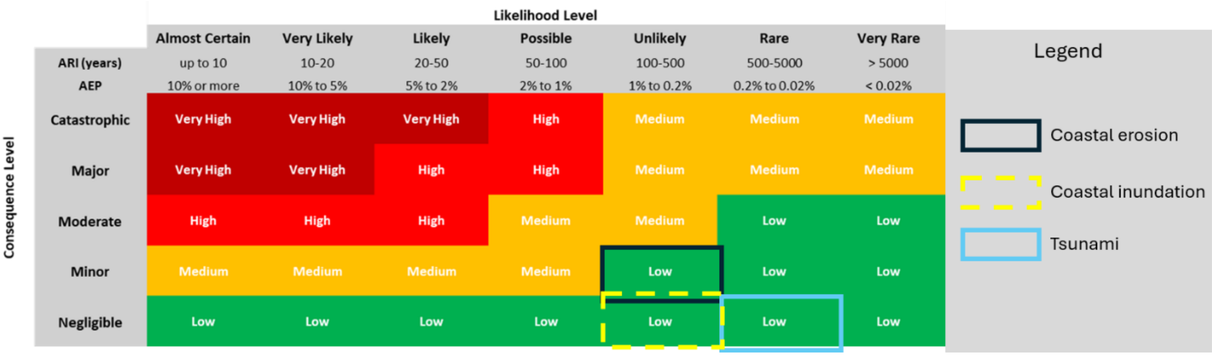


Figure 6-2: Risk outcome for coastal erosion, inundation and tsunami

7 Proposed avoidance, reduction and mitigation measures

The effect of the proposal on coastal processes is assessed as being minor. There is no practicable way of avoiding all effects with the current proposal as there is an occupation as a result of the reclamation. The modified bird roost provides some habitat replacement of the spit habitat affected by the reclamation.

8 Proposed monitoring conditions

8.1 Capital dredging related monitoring

Apart from the monitoring and management of the dredge plume, no other monitoring is considered necessary from a coastal processes' perspective.

8.2 Long term monitoring requirements

The areas to monitor for long term potential change are within Marsden Bay. Much of these areas are already subject to hydrographic survey, but intertidal and subaerial survey should be carried out at the same time to provide a comprehensive topographic and bathymetric data set. Surveys should be carried out after completion of each stage of the development and at least annually for a period of not less than five years.

Monitoring elevation changes (if any) in seabed and shoreline in these areas is the most useful form of long-term monitoring combined with ongoing measurement of waves and water level at the Wave Rider Buoy so that changes in shoreline and seabed elevations can be assessed together with changes in wave energy and water level fluctuations. Sediment sampling and analysis of surficial sediments within the eastern end of Marsden Bank could also be carried out to confirm any change in sediment properties that may potentially affect ecology in this area.

It is anticipated that the turning area will need to be dredged occasionally as part of the shipyard operations. Surveying of this area should be done annually and include the dredged extent including the side slopes and at least 500 m of seabed to the west and north of the dredged area

9 Applicability

This report has been prepared for the exclusive use of our client Ministry of Business, Innovation & Employment, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and that an Expert Panel as the consenting authority will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its regulatory functions.

Compliance with the Environment Court Practice Note 2023

We confirm that, in our capacity as authors of this report, we have read and abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses contained in the Practice Note 2023

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Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
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Appendix A Criteria for describing the magnitude of effects on coastal processes

Significance	Criteria: Coastal Processes
Very High /severe	Total loss of, or very major alteration to, key elements/features of the existing baseline condition such that the post-development character, composition and/or attributes will be fundamentally lost. This includes irreversible changes to tides, currents, waves and/or sand transport causing adverse impacts on significant parts of the shorelines of Marsden Bay or the lower Whangārei Harbour, causing increased erosion and/or significant environmental habitat values. Substantial changes to the seabed morphology such that: • the majority of the regional distribution of a habitat type for nationally protected ecological communities is lost or substantially depleted; or such that • the sediment pathway for sand flow to other areas is permanently intercepted.
High (Significant)	Major loss or alteration to key elements/features of the existing baseline condition such that the post-development character, composition and/or attributes will be fundamentally changed. In particular, extensive or acute disturbance (major impact) occurring to the shorelines bordering Marsden Bay, causing increased erosion and/or significant environmental habitat values. Also, substantial changes to the seabed morphology such that: • the majority of the regional distribution of a habitat type for regionally protected ecological communities is lost or substantially depleted; or such that • the sediment pathway for sand flow to other areas is temporarily intercepted.
Moderate /medium (More than minor)	Loss or alternation to one or more key features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed. Changes to tides, currents, waves and/or sand transport affecting parts of the shorelines bordering Marsden Bay or the lower Whangārei Harbour, causing short term increased erosion that would affect communities or habitat values, such that natural recovery or mitigation measures would alleviate adverse impacts. Also, substantial changes to the seabed morphology such that the local distribution of a locally valued seabed habitat type is permanently lost or substantially depleted.
Low/minor	Minor shift away from existing baseline conditions. Changes arising will be discernible, but attributes of the existing baseline condition will be similar to pre-development circumstances or patterns. Changes to tide levels, currents, waves and/or sand transport processes causing changes in shoreline stability of limited or temporary nature. Changes to the seabed morphology would be of local spatial extent with no impacts elsewhere.
Negligible	Very slight changes from the existing baseline conditions. No perceptible impacts on regional hydrodynamics beyond the immediate works area. Local hydrodynamic changes that have no consequent adverse impacts elsewhere. Little or no changes

(Less than minor)	to water level, current, wave or sand transport processes at shorelines such that any impacts to shoreline stability would be imperceptible. Changes to the seabed morphology would be temporary with only local spatial extents and no impact elsewhere.
No effect (Nil)	No detectable change in physical parameters.
Beneficial	Any effects or measures that are expected to result in reduced shoreline erosion where that is presently a problem, or design features or management activities that would make a positive contribution to shoreline amenity or coastal environmental values.

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