REPORT

Eastland Port Dredging: Surf Break Risk Assessment

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Executive summary

Eastland Port are seeking resource consent to undertake capital dredging to deepen the port entrance channel and to maintain this deeper level with annual maintenance dredging. The consent application also includes disposing of dredge material at an existing offshore disposal site. As part of a resource consent application, Eastland Port have commissioned Tonkin & Taylor Ltd (T+T) to assess the risk that these activities pose to local surf breaks. The scope of this assessment has been to:

- Review technical reports related to the proposed dredging activities.
- Review coastal processes within Poverty Bay.
- Review surf break and dredge specific modelling assessments undertaken for Eastland Port.
- Review surf break guidance and regulations.
- Undertake a risk assessment for surf breaks potentially impacted by the proposed works.

The consent application is for a capital dredging volume of 140,600 m^3 to reach a target channel depth of -11.6 m (chart datum), and maintenance dredging of up to 140,000 m^3/yr. This will result in a port entrance channel that is on average 0.6 m deeper than present. Materials will be deposited at an offshore disposal site some 5 km southeast of the Port near the centre of Poverty Bay.

Coastal processes in Poverty Bay are influenced by two large rivers (Turanganui and Waipaoa) that discharge freshwater and a large supply of sediment (13.7 Mt annually) to the bay. The sedimentary coastline between the Waipaoa River and Turanganui River has a long-term trend of accretion due to the supply of sediment. Poverty Bay is exposed to ocean waves from the south and southeast and has a met-ocean climate that is favourable for surfing, with moderate size swell waves and a predominant offshore wind direction. Three well know surf breaks are located in the sedimentary section of Poverty Bay, including Waikanae, Midway and the Waipaoa River mouth. Additional surf breaks near are located on rocky and reef coasts to the east of Eastland Port, including Cliffs (near Kaiti Beach), Sponge Bay and Tuamotu Island.

An initial screening was used to identify the surf breaks within Poverty Bay that could potentially be affected by the dredging activity. Due to the location of the works and potential effect on waves approaching the break ('the swell corridor'), surf breaks along Waikanae Beach (Roberts Road), Midway Beach (The Pipe) and the Waipaoa River mouth (Big River) were identified as having the potential to be affected. Surf breaks to the east of the port, including The Cliff (Kaiti Beach), Sponge Bay and Tuamotu Island (The Island) were screened to be low risk because the port works are located outside the swell corridor for these breaks. At Midway and Waikanae, incoming waves pass over the port entrance channel before breaking. For the Waiapoa River mouth, waves pass over the dredge disposal grounds before arriving at the surf break. Therefore, a detailed assessment was undertaken specifically for the Waikanae and Midway section, and the Waipaoa River mouth.

The assessment method was based on identifying the physical elements influencing the use and enjoyment of each surf break, then assessing the impacts of the proposed port activity on these. The likelihood and consequence of the impact on each element was assessed. To undertake this assessment, a framework outlined in a national guidance document was followed (Atkin et al., 2018). A risk matrix based on the identified likelihood and consequence was used to identify a risk rating that exists on a continuum from low to catastrophic.

The dredging activity was found to result in a ± 2% change in wave height at Waikanae and Midway, and a ± 1 to 2° change in wave direction based on MetOcean modelling assessments. The deposition of material at the dredge disposal ground was also modelled by MetOcean to cause a ± 0.2% change in wave height at the Waipaoa River mouth and a negligible change in wave direction. At all surf breaks (Midway, Waikanae and Waipaoa River mouth), the maximum consequence for individual surfing elements was *minor*, the maximum likelihood was *unlikely* and the overall risk of the proposed port activity on surfing was identified to be *low*.

1 Introduction

Eastland Port Limited (EPL) are seeking resource consent to undertake several port improvements that include, capital and maintenance dredging and offshore disposal (Figure 1-1). Tonkin & Taylor Ltd (T+T) were engaged by EPL to assess the risk that these activities pose to local surf breaks. The scope of this assessment is to assess the risk of proposed works on surf breaks within Poverty Bay by reviewing technical assessments undertaken by MetOcean and Worley that are appended to the 4Sight Assessment of Environmental Effects (4Sight, 2021). A full list of references is presented at the end of this report. The scope included the following tasks:

- Review technical reports related to the proposed dredging activities.
- Review coastal processes within Poverty Bay.
- Review surf break and dredge specific modelling assessments undertaken for Eastland Port by MetOcean.
- Review surf break guidance and regulations.
- Describe surf breaks within the Poverty Bay area with regards to the swell corridor and optimal conditions.
- Identify surfing spots that could potentially be affected by the proposed works.
- Undertake a risk assessment for surf breaks potentially impacted by the proposed works.

The surf break risk assessment was undertaken using a two-stage approach. First, surf breaks that could have at least one physical element impacted by the proposed works were identified. This was done by assessing whether the proposed works cross the surf-break swell corridor. A detailed risk assessment that covers different surf break elements was then undertaken for the potentially impacted breaks. Surf breaks with a swell corridor not being potentially impacted by the works were assessed as having low risk. This method is outlined in more detail in Section 3.

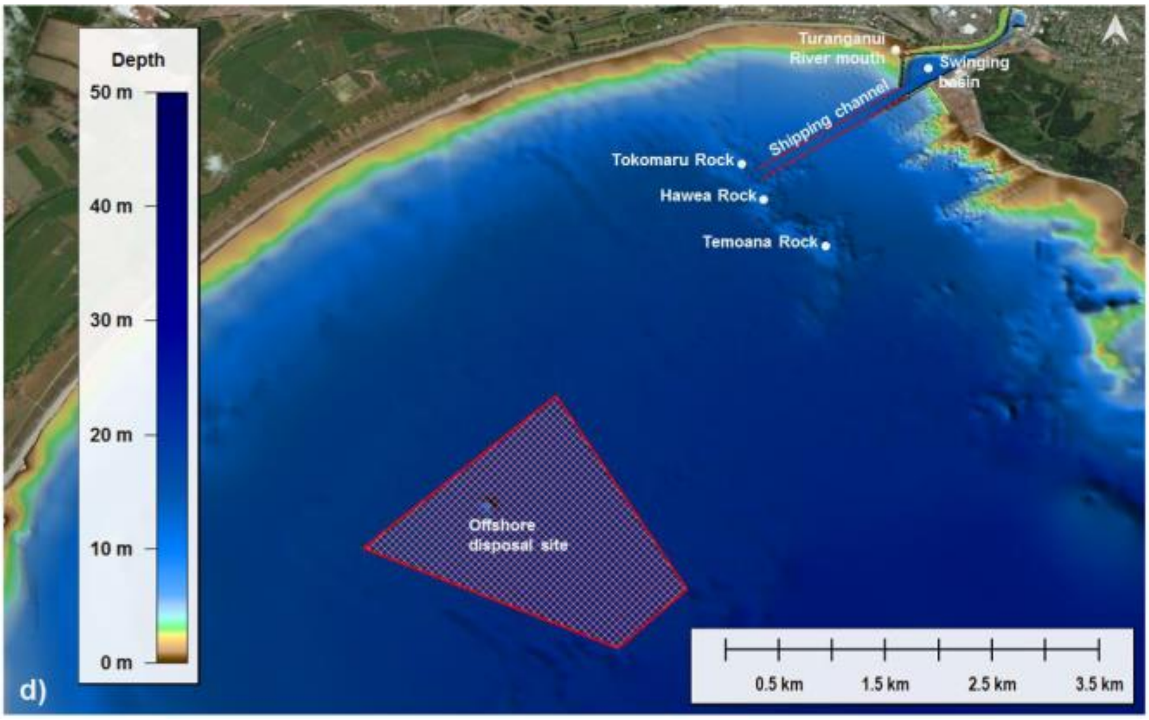


Figure 1-1: Location of proposed channel dredging and disposal works (Source MetOcean 2018).

2 Coastal setting

2.1 Port location

Eastland Port is located at the north-eastern aspect of Poverty Bay on the east coast of the North Island (Figure 2-1). The port was established at the mouth of the Turanganui River in the late 1800's but was separated from the river in the 1920's with the construction of training walls and breakwaters (Figure 2-1). The river training works were required to prevent the port basin from silting up from river transported sediment. The river separation works resulted in the river flowing out at towards Waikanae Beach, where a river training structure is located along the rivers west bank, and a seawall is located along the first 100 m of beach. The port basin is separate to the river, with multiple berths on the eastern side and is closed to the sea with a butlers wall that marks the west edge of the port basin, and a breakwater that marks the south edge of the entrance channel (Figure 2-1).

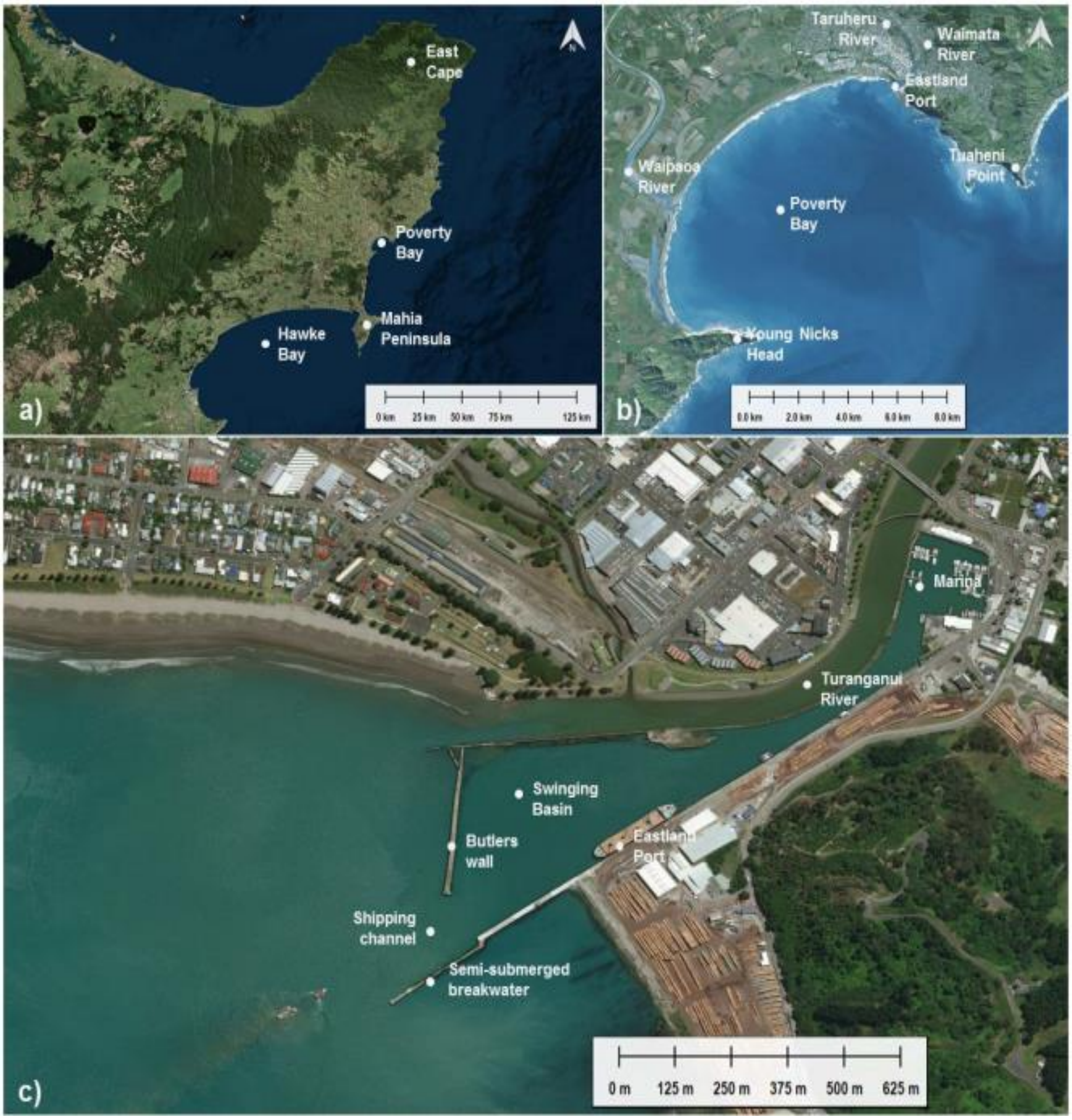


Figure 2-1: Site location (Source MetOcean 2018).

2.2 Proposed port works

The proposed works and activities are described in detail by others and are not repeated here. In relation to surf breaks, the proposed dredging and disposal have been identified as potentially influencing the surfing experience at nearby spots such as The Pipe, Roberts Road, and Big River (MetOcean, 2021). The proposed works include dredging the entrance channel and port basin and depositing dredge disposal offshore in the centre of poverty bay. The locations of key dredging sites are presented in Figure 2-2 in context of surf breaks of regional and national significance.

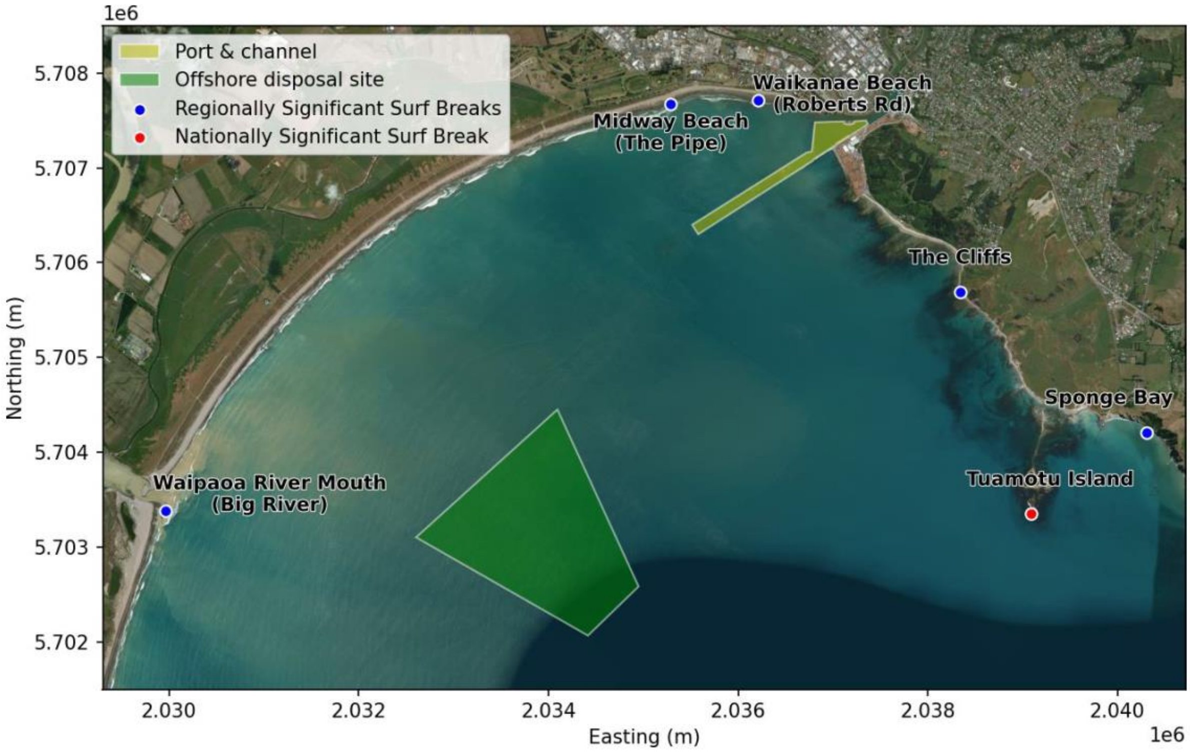


Figure 2-2: Proposed dredging and disposal sites in relation to surf breaks of regional and national significance (source MetOcean, 2021)

Despite being separate from the Turangaui River, sediment deposition still occurs in the port basin and entrance channel, which is disruptive to port operations. Sedimentation is actively managed by Eastland Port through capital and maintenance dredging. The proposed port upgrade includes an application for resource consent to deepen the entrance channel and some sections of the outer port through capital dredging, and to maintain a new deeper bed level through maintenance dredging. Details on the proposed dredging levels, areas and volumes are presented in other reports. The total capital dredging volume is 140,600 m^3 and the maintenance dredging application is for up to 140,000 m^3/yr, with the actual volume extracted each year being dependent on weather events and climate patterns.

In context of surfing effects, dredging the port navigation has potential to influence wave processes approaching Pipe and Roberts Road (MetOcean, 2021). The target bed level for dredging the port navigation channel is -11.6 m relative to chart datum (CD). The difference in bed level will vary depending on the existing level, as indicated in Figure 2-4 where the difference in bed level from the existing site and post dredging is compared. In addition, disposal of dredge material has potential to influence wave processes and sediment dynamics approaching Big River.

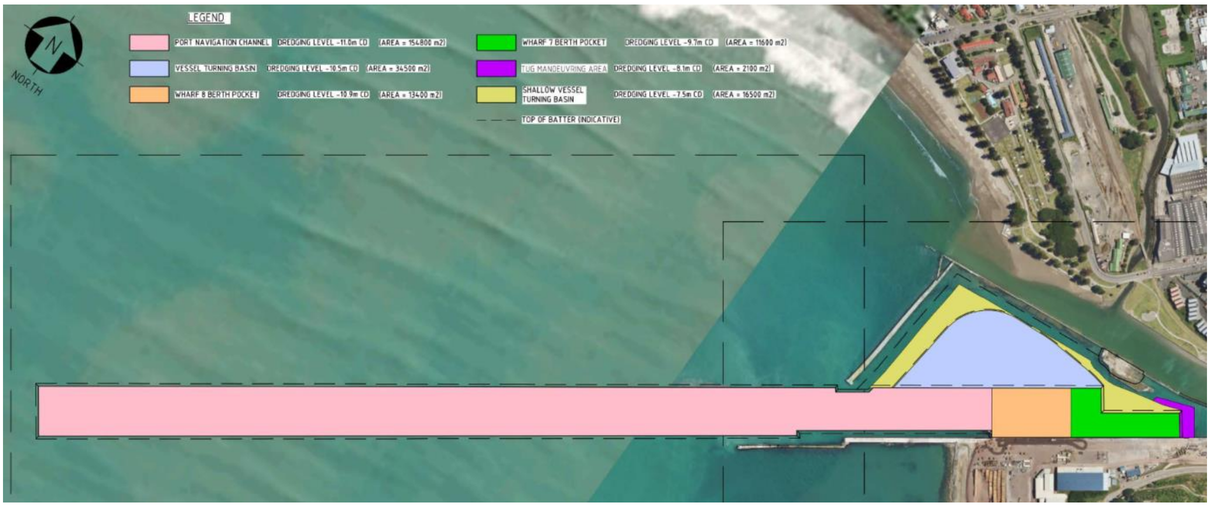


Figure 2-3: Proposed dredging locations (source: Worley, 2021).

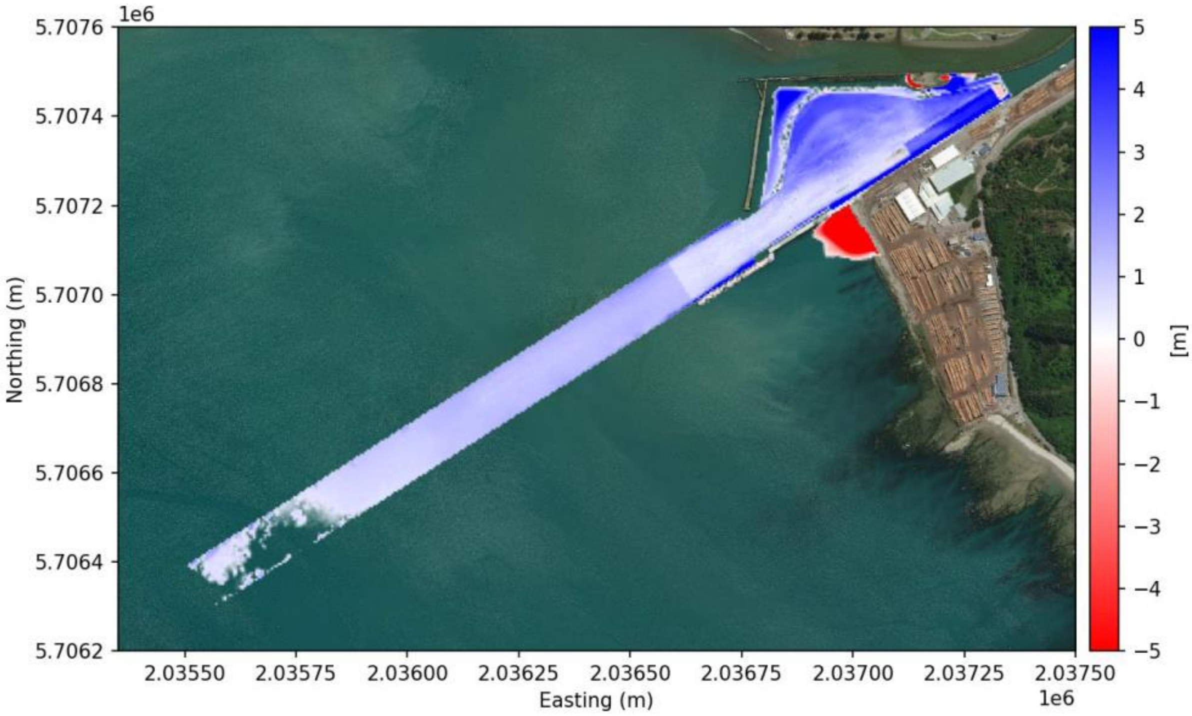


Figure 2-4: Change in bed level from proposed works (source: MetOcean, 2021).

2.3 Coastal processes

This section highlights the key coastal processes that influence surf breaks in Poverty Bay, between Sponge Bay and Young Nicks Head. Additional details on the wave climate and coastal processes are available in MetOcean reports. Key coastal process influencing surf breaks are outlined in Figure 2-5 and are tabulated below:

- Environmental conditions in Poverty Bay are favourable for surfing, with consistent waves entering the bay from the south-southeast (140 – 170 degrees) and a predominant wind climate that blows offshore (from the northwest).
- Two larger rivers discharge into Poverty Bay and continue to supply the system with sediment:
  - The Turanganui River discharges at eastern end of Poverty Bay and inputs approximately 0.7 Mt of sediment into the bay per year (Shand, 2017).
  - The Waipaoa River currently discharges 8.5 km west of Gisborne township and adds approximately 12.9 Mt of sediment into the bay per year (Shand, 2017). A river delta occasionally forms exceptional surfing conditions following deposition of gravel material after high flow events.
- Poverty Bay is characterised by a range of coastal features, that include:
  - Cliff shorelines from Sponge Bay to the Turanganui River mouth with complex shore platforms, offshore reefs, headlands, and an offshore island (e.g., Tuamotu):
    - Cliff coastlines have experienced long-term erosion in recent decades (-0.25 m/yr), which supplies some sediment into the nearshore system.
  - A small sandy beach (Kaiti Beach) is present east of the port, below Kaiti Hill.
  - A vast sandy beach system extends from the Turanganui River to the Waipaoa River, which includes popular surf breaks at Waikanae (Roberts Road) and Midway (The Pipe):
    - The beach curves from south facing at the Turanganui River to ESE facing at the Waipaoa River, which results in different exposures to wind and wave conditions.
    - A long-term trend of accretion has been detected along the entire sandy beach, with higher rates at the Waiapaoa end (+1.28 m/yr) and lower rates at Midway (+0.37 m/yr) and Waikanae (+0.12 m/yr).
    - Nearshore bars are present along the sandy beach system, which appear to be more consistent in form at well-known surf spots.
  - A sedimentary spit is present on the west side of the Waipaoa River (Muriwai) which extends towards Young Nicks Head and is backed by a shallow inlet.
- Many nearshore features influence waves arriving at surf spots, including:
  - Young Nicks Head and the shoal offshore of the headland (Kauri Banks) shadow and refract wave entering the western end of poverty bay between Muriwai and the Waipaoa River, when waves are from a more southerly angle.
  - Tuaheni Point and shallow reefs offshore of Sponge Bay shadow some wave energy entering Poverty Bay when waves are from a more easterly direction.
  - A series of submerged reefs south off the port navigation channel (Tokomaru Rock, Hawea Rock and Temoana Rock) refract and split incoming waves that approach the stretch of coast between Waikanae and Midway.

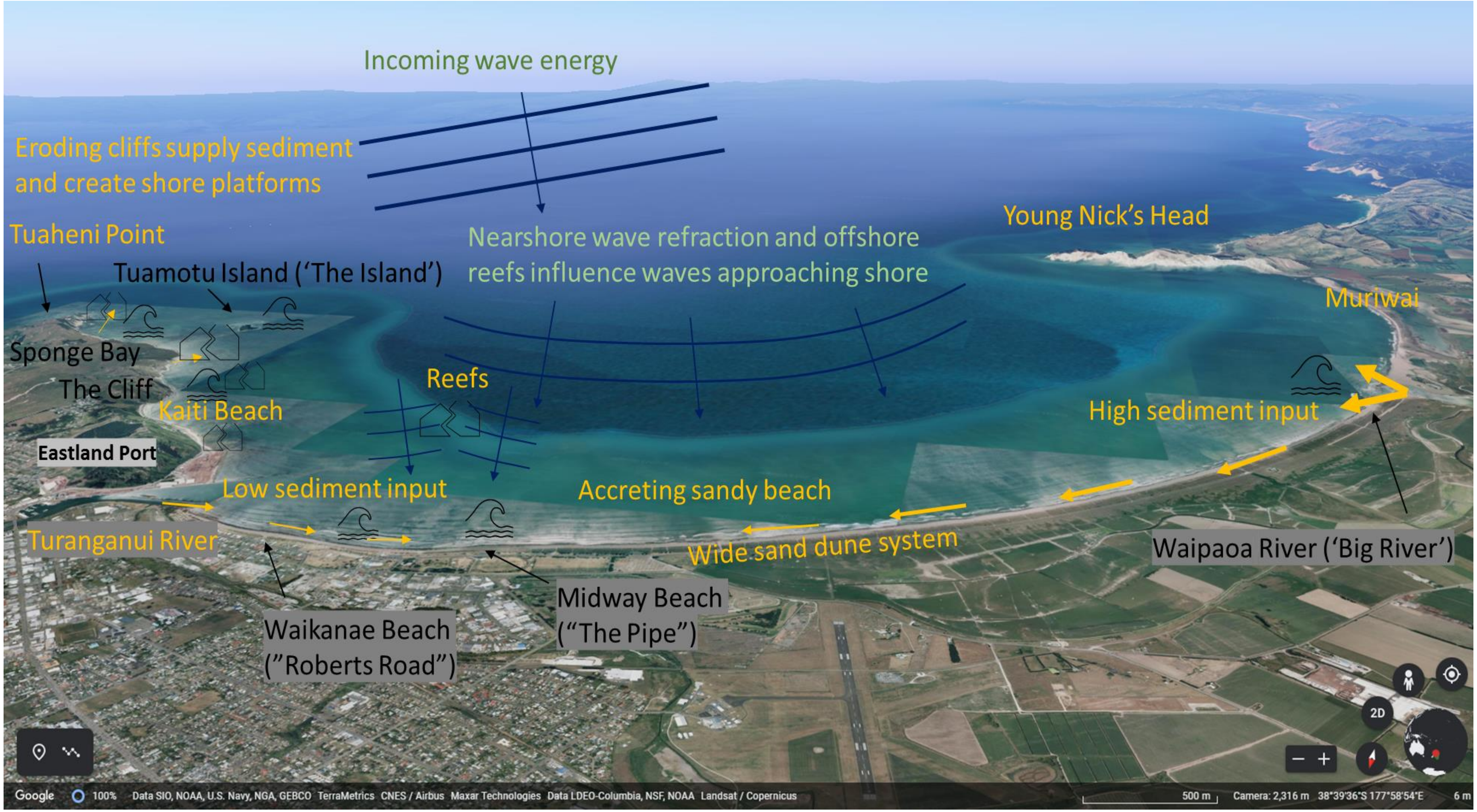


Figure 2-5: Overview of coastal processes, features, and surf breaks adjacent to Eastland Port.

2.4 Surf breaks

Several surf breaks are present in the Poverty Bay area outlined above, of which six are of regional or nationally significance (Figure 2-2). This section presents a brief description of each break with reference to optimal conditions based on the New Zealand Surfing Guide (Morse and Brunskill, 2004) and first-hand experience. The description of each break includes a reference to the location of the proposed port works with regards to the surf break swell corridor. Where the swell corridor is the region offshore of the surf break where ocean swell travels and transforms towards a surfable wave (DoC, 2010; Atkin et al. 2018). The location of proposed works relative to the swell corridor is used as an initial screening step to identify which breaks could potentially be affected by the proposed works by Eastland Port. Where the proposed works are located in the swell corridor the risk to surfing is assessed in detail.

2.4.1 Sponge Bay

Sponge Bay is a regionally significant surf break (Peryman, 2011) that is known for having mellow waves that are good for learners, with a range of average quality waves that offer sheltered conditions where other nearby spots are wind affected (Morse and Brunskill, 2004). Breaks work best on a south to south-east swell and are offshore in north/northwest wind. Waves break on a mix of sand and rock, with the mid to high tide stage typically preferred for surfing.

Sponge Bay is located 4 km south-east of the port entrance channel and 4 km east of the dredge disposal grounds. Sponge Bay surf breaks are located seaward of the port dredging and disposal areas and the proposed works are therefore outside of the swell corridor.

2.4.2 Tuamotu Island ('The Island')

The Island is a nationally significant surf break with a 10/10 rating in the New Zealand Surfing Guide (Morse and Brunskill, 2004). The island is located offshore of Sponge Bay and can be accessed by walking across a shingle ridge at low tide, or by paddling across the passage. The Island offers world class rides at three discrete breaks, with a right breaking wave on the southeast side and a left breaking wave on the southwest side. The left is more regularly surfed with the 'Bowl' section at the outside that produces hollow tube rides and a steep fast peeling ride. On large swells, the left continues around the west side of the island and forms a high-speed point/reef break with barrel and turn sections. All breaks are on shallow reefs and are best suited to experienced surfers.

Optimal surf conditions occur at low to mid tide when swell is from the south to southeast and wind is from the north or east (Morse and Brunskill, 2004). Tuamotu Island is located 4 km southeast of the port entrance channel and 4 km east of the dredge disposal grounds. The island is located seaward of the port dredging and disposal areas and the proposed works are therefore outside of the swell corridor.

Figure 2-6: Surf at The Island (Source: T+T, 2018)

2.4.3 The Cliff

The Cliff is a regionally significant surf break located seaward of the cliff at the east end of Kaiti Beach. The Cliff is a left reef break that is inconsistent and needs a large south swell to break (Morse and Brunskill, 2004). The Cliff is located 1.2 km southeast (seaward) of the port entrance channel and therefore the proposed works are located outside of the breaks swell corridor.

2.4.4 Roberts Road (‘Waikanae Beach’)

Waikanae beach is a regionally significant surf beach that offers a range of surf breaks that are generally considered mellow and good for learning (Morse and Brunskill, 2004). The wave height is generally lower than the surrounding coast due to shadowing by Tuaheni Point and Kaiti and the shifting sand bars produce gentle peeling rides (Morse and Brunskill, 2004). Roberts Road is at the west end of the Waikanae section and is popular with surf schools due to the proximity to town and is close to the surf patrol area. Roberts Road can produce high quality waves in the right conditions and during a large southerly swell. Optimal conditions for surfing at Waikanae occur when waves approach from the southeast with wind from the north. The beach can be surfed at all tides.

Waikanae Beach is located directly adjacent the Turanganui River mouth and extends for 1 km to the west of the river and Port. The surf breaks along the Waikanae Beach section are directly landward of the port entrance channel and therefore the proposed works are inside the swell corridor.

Figure 2-7: Surf break at Roberts Road (Photo: T+T, 2018)

2.4.5 Midway Beach ('The Pipe')

The Pipe is a regionally significant surf break with a 9/10 rating in the New Zealand Surfing Guide (Morse and Brunskill, 2004). The break at Pipe offers high quality and consistent beach break peaks for experienced and intermediate surfers. The break at Pipe includes right and left breaking waves with potential for tube rides and long rides with many sections for performing manoeuvres. Pipe is a popular break and is a go to spot for experienced and competent surfers so can be crowded.

Optimal surf conditions at Pipe are associated with offshore wind from the north and waves form the southeast. The break maintains a rideable pealing waves at a range of sizes, from 0.5 to 2.5 m and is good at all stages of the tide. The seaward end of the port entrance channel is located 1.4 km offshore The Pipe surf break. Therefore, the proposed works to deepen the entrance channel is located within the swell corridor.

Figure 2-8: The Pipe surf break at Midway Beach (Photo Cory Scott, NZsurfmag.co.nz) © Cory Scott Imagery

2.4.6 Waipaoa River (‘Big River’)

A regionally significant surf break with a 7/10 rating in the New Zealand Surfing Guide (Morse and Brunskill, 2004). Big River is an inconsistent spot that can produce world class left and right breaking waves when conditions line up on rare occasions. The best surfing conditions at Big River occur after large river flows push out and develop an ebb delta/bar which allows waves to peel at a surfable angle. During calmer conditions, the delta is moved landward towards the beach a straightens out which degrades wave quality. The shape of nearshore bars at Big River is therefore highly dynamic and influenced by rainfall and sedimentation in the wider catchment. Surfing at the Waipaoa River mouth can be dangerous with strong currents and wooden debris flowing after rainfall.

Optimal conditions for surfing occur with east or southeast swell and westerly offshore wind with the break usually offering the best rides at mid to high tide. The Waipaoa River mouth is located 3 km west of the dredge disposal grounds, which means the proposed disposal is within the swell corridor for the Big River surf break. The port entrance channel is located northeast of the break and is therefore outside of the swell corridor.

Figure 2-9: The Big River surf break at the Waipaoa River mouth (Photo Cory Scott, NZsurfmag.co.nz) © Cory Scott Imagery.

3 Assessment framework

3.1 Context

The NZCPS (2010) guidance note on Policy 16: Surfbreaks of national significance, states that *surf breaks are an important recreational resource for New Zealanders and international visitors and contribute significant economic and social benefits to both local communities and New Zealand. The integrity of surf breaks, access to them, and their use and enjoyment are vulnerable to adverse effects from development on land and in the coastal marine area.*

The NZCPS (2010) guidance note suggests that the quality of the wave can potentially be compromised by developments in the swell corridor seaward of the break or by changes in the seabed form at the break point. Further, the enjoyment of surf breaks by surfers can be compromised by discharges, limitations on access, and changes to natural character. Several examples of activities which can threaten or compromise the quality of a surf break are provided including discharges, sedimentation, structures, dredging and spoil disposal, along with changes in natural character and limitation of access.

Since surf breaks were adopted in the NZPS (2010), guidance has been developed for assessing the risk of an activity on surf breaks. Here, we adopt a risk assessment framework based national guidance (Atkin, 2018) and experience from assessing risk at specific surf breaks (Shand et al., 2019). The approach includes understanding how the proposed activity will influence physical elements that define usage and enjoyment of a surf break, then application of a risk score that is based on a combination of likelihood and consequence.

3.2 Physical elements of a surf break

To robustly assess the potential for an activity to affect a surf break, the physical elements which defined the use and enjoyment of the surf break must first be identified. Based on the potential for the proposed physical works to affect these elements, appropriate methodologies to quantify effects can then be developed. Where risks exist or are identified to be high, appropriate mitigation measures can be implemented.

Physical elements contributing to the use and enjoyment of surf breaks near Eastland Port are set out in Figure 3-1 and Table 3.1. These have been based on a combination of those provided in literature (e.g., Shand et al., 2019 and Atkin, 2018). A preliminary assessment of the ways in which these elements may be affected is set out below along with proposed methodology for assessing these effects. These methodologies are further developed in following sections.

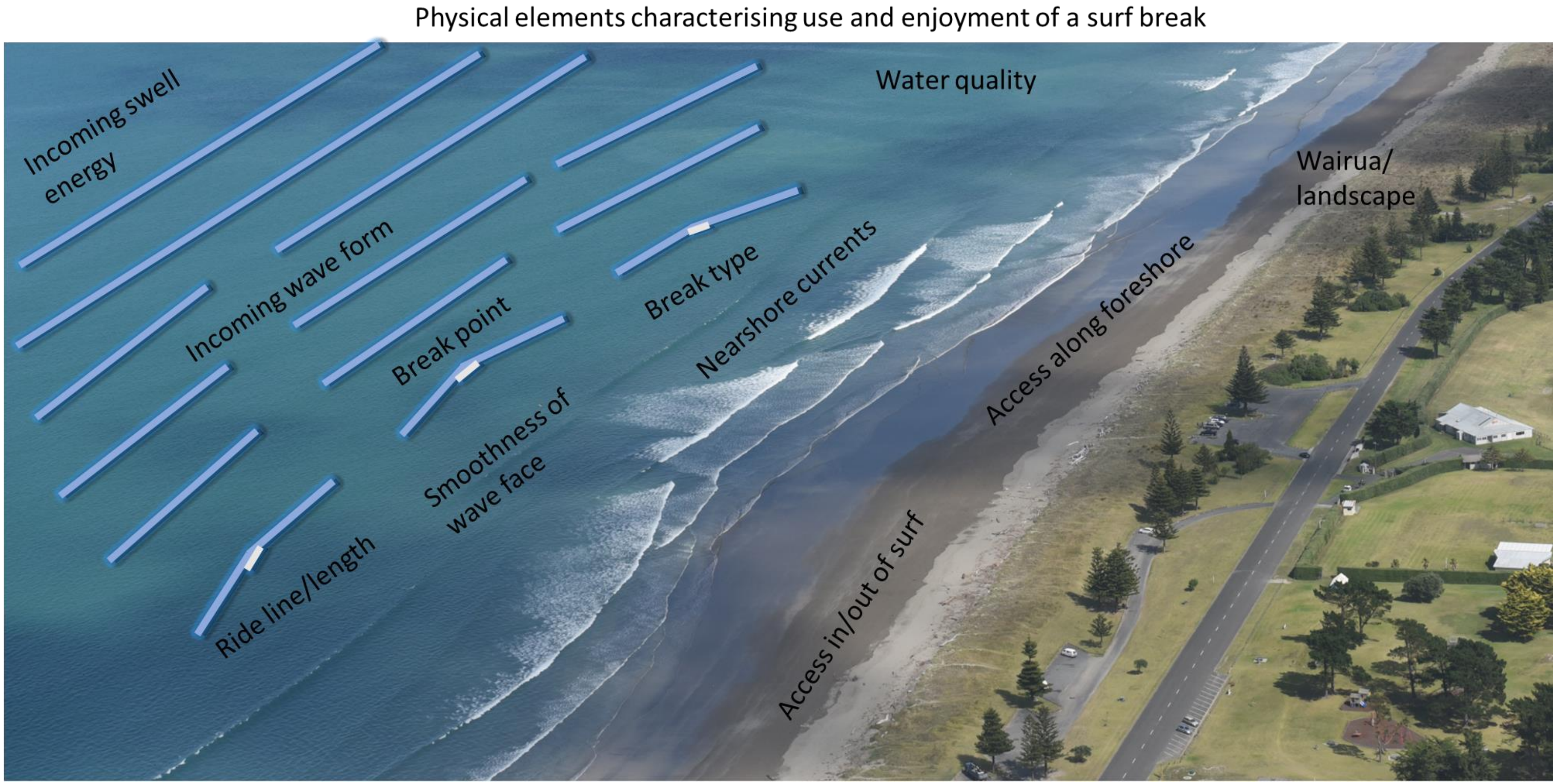


Figure 3-1: Physical elements defining the use and enjoyment of a surf break. Photo from T+T (2018) of Midway Beach and the Pipe surf break.

Table 3.1: Proposed methodology for assessing potential physical effects on surf breaks potentially effect surf break

Physical elements defining the use and enjoyment of a surf break	Description and ways by which the surf break may be affected	Assessment method works proposed by Eastland Port
Incoming swell energy	Controlled by swell corridor offshore that influences wave energy reaching break. Can be affected by an offshore obstacle or changes in seabed.	Review of MetOcean wave hindcast and surf break modelling.
Incoming wave form	Controlled by offshore and nearshore bathymetry that shoal, refract, and diffract waves prior to breaking. Can be affected by offshore structures or change to the seabed.	Review of MetOcean wave hindcast and surf break modelling.
Breaking location/style	Dependent on seabed morphology at breakpoint and offshore pre-conditioning (refer incoming wave form).	Interpretation of MetOcean wave modelling results to assess change in wave energy that may impact currents and nearshore sandbars.
Smoothness of wave face	Affected by wind, reflected waves, prior breaking inducing decomposition, irregularity in seabed.	Not considered relevant to proposed works at Eastland Port.
Ride line/length	Affected by structures or other objects in the ride line or change in bathymetry along ride line.	Not considered relevant to proposed works at Eastland Port, unless significant change to sediment supply is detected.
Currents	Can be affected by surf zone circulation, modification of tidal flows. Can be interrupted by changes in wave form, structures, and interruption to sediment transport.	Interpretation of MetOcean wave modelling results to assess change in wave energy that may impact currents and nearshore sandbars
Access onto foreshore	Interruption of access between backshore (or arrival) and the foreshore (of surf access).	Not considered relevant to proposed works at Eastland Port
Access along foreshore	Interruption of safe access along the foreshore.	Not considered relevant to proposed works at Eastland Port
Access into/out of surf	Interruption of safe access into/out of water.	Not considered relevant to proposed works at Eastland Port
Water quality	Can be affected by discharges into the CMA, such as uncontrolled nearfield dredge disposal.	Interpretation of plume modelling and Environmental Effects Assessment reports
Wairua/Landscape	Factors affecting the look and feel of a surf break.	Not assessed by us

3.3 Risk classification

Risk classifications exist on a continuum from null to catastrophic and are assigned based on the combination of likelihood and consequence. The proposed framework for assessing risk in Atkin et al (2018) allows a nationally coherent method that defines different levels of consequence (Table 3.2) and likelihood (Table 3.3) affecting a surf break area (SBA). Depending on the combined likelihood and consequence, a risk classification can be assigned using the matrix in Table 3.4.

Table 3.2: Consequence definitions from Atkin et al (2018)

Consequence of activity	Category	Definition	Example
Catastrophic	1	Permanent/irreparable damage to/loss of the whole surf break(s)	Occupation of SBA Major reclamation Port construction
Major	2	Activity permanently effects access to and/or enjoyment of a surfing resource; and/or activity results in on-going health and safety issues; and/or potential for physical changes to a large part of the SBA; and/or a permanent change to the natural character, aesthetic or wilderness attributes of the surfing resource.	Complete loss of access to break (except by sea) Reduced ride length. Reduced wave quality Wastewater outfall Coastal protection works Coastal landscape altered by coastal development
Significant	3	Activity temporally effects, for sustained periods of time, access to and/or enjoyment of a surfing resource; and/or activity results in health and safety issues. No physical impacts	Turbid water Contamination Regulated access Ski-lane
Minor	4	Activity temporally effects access and/or enjoyment to a surfing resource for relatively short periods of time (e.g. <24 hours). No physical impacts	Beach closure for sporting events/surf carnival

Table 3.3: likelihood definitions from Atkin et al (2018)

Likelihood of impact	Category	Definition
Very Likely (Permanent/ Frequent)	A	Will obviously occur frequently and/or permanently, activity being undertaken in SBA; examples exist of impact; and/or a sensitivity rating: 5
Likely (Frequent)	B	Potential for activity to occur frequently, activity being undertaken in or near to SBA; and/or similar examples exist; and/or sensitivity rating: 3-4
Moderate (Occasional)	C	Potential for activity to occur, activity being undertaken near to SBA or within catchment; and/or examples exist; and/or sensitivity rating: 2-3
Unlikely (Remote)	D	Activity unlikely to occur, activity being undertaken outside of catchment and/or embayment; no examples exist; and/or sensitivity rating: 1-2
Highly Unlikely (Rare)	E	Activity high unlikely to occur, activity being undertaken outside of catchment and/or swell corridor no examples exist; and/or sensitivity rating: 1

Table 3.4: Risk rating matrix from Atkin et al (2018)

Risk Rating Table					
		Catastrophic-1	Major-2	Significant-3	Minor-4
Very Likely	A	Extreme	Extreme	Extreme	High
Likely	B	Extreme	Extreme	High	Moderate
Moderate	C	Extreme	Extreme	High	Low
Unlikely	D	Extreme	High	Moderate	Low
Highly Unlikely	E	High	High	Moderate	Low

The classification system presented in Atkin et al (2018) also includes a sensitivity rating that scales the effect of an activity based on the surf break type and underlying coastal geomorphology. This accounts for how sandy beach breaks are potentially more effected to interruptions to sediment movement compared to reef breaks. The Surf Break Sensitivity Rating form Atkin et al (2018) is presented in Table 3.5.

Table 3.5: The Surf Break Sensitivity Rating form Atkin et al (2018)

	Potential Break Type	General Material Size	Wave Quality Reliance on Sediment Transport Regime
1	Rock Ledge; Reef	Consolidated Rock	Low
2	Reef; Point		
3	Point; Beach; Delta		
4	Beach; Delta		
5	Delta	Fine Sand	High

3.4 Application to proposed Eastland Port works

The assessment framework outlined here, including an assessment of physical elements and risk is presented in full for select breaks at Waikanae Beach, Midway Beach and The Waipaoa River mouth. These surf spots are either beach breaks or river delta breaks and are therefore considered sensitive to activity that could interrupt existing sediment dynamics. Further, the proposed dredging for the port navigation channel is within the nearshore swell corridor for Waikanae and Midway Beach, and the proposed dredge disposal ground is within the nearshore swell corridor for The Waipaoa Rivermouth. The assessments for Waikanae and Midway Beach are combined because the proximity of the breaks means that any effect to one spot will affect the other. The assessment for the Waipaoa River mouth is presented separately. No detailed assessment is presented for Sponge Bay, The Island or The Cliff because these spots are all located seaward of the proposed works, meaning that their 'swell corridor' and incoming wave energy cannot be affected by the works proposed by Eastland Port. Further, these spots are all reef or rock breaks that are less sensitive to sediment dynamics. Therefore, the risk to Sponge Bay, The Island and The Cliff is low when applying the Atkin rating.

4 Waikanae and Midway ('Pipe')

4.1 Coastal processes influencing surf breaks

The surf breaks at Midway and Waikanae are influenced by the sedimentary morphology in the nearshore (i.e., position of sand bars) as well as offshore processes which pre-condition incoming wave forms. In terms of coastal morphology, this section of has a long-term trend of accretion, with a higher rate of accretion at Midway compared to Waikanae. Shoreline accretion is attributed to sediment supply from the Turanganui River and the Waipaoa River. Discharge from the Turanganui River is controlled by river separation training walls and the outflow is orientated almost 90 degrees to the shoreline. This means river flow and sediment is directed straight into the nearshore and surf-zone. Sediment input form the Turanganui is considered relatively low (0.7 Mt/yr), but the direct proximity and orientation make this the likely dominant source for Waikanae. Midway Beach is located further along the coast from the Port and is likely influenced by an alongshore supply of sediment from the Waipaoa River (which supplies 12.9 Mt/yr of sediment to Poverty Bay), as well as some supply from the Turanganui River. This input of sediment helps to form nearshore sand bars where surfing takes place and replenishes sediment that is mobilised and transported away during storms.

The offshore wave climate entering Poverty Bay was assessed by MetOcean (2017). The regional wave climate is influenced by Southern Ocean and Pacific Ocean climate patterns, and regional topographic influences from Mahia Peninsula, Young Nicks Head, and Tuaheni Point. Therefore, the optimal wave direction for surfing at Midway and Waikanae is from the south and southeast (140 – 180 degrees), which occurs for 70% of the time (MetOcean View output point 178.0500, -38.7400, NZ Wave Gisborne model). An example is presented in Figure 4-1 showing the regional wave height distribution associated with a large southerly event, highlighting the influence of large scale topographic and bathymetric features, and smaller features such as reefs near the port entrance channel. In the context of incoming wave energy offshore of Midway and Waikanae Beaches, the mean wave height calculated in the 10-year MetOcean hindcast is 1.0 m, with a range of wave periods between 6 – 16 seconds common. Wave heights exceeding 2 m occur around 5-10% of the time, which could be associated with good to epic surf conditions.

An important background to the surf breaks at Midway and Waikanae Beaches is how incoming waves interact with offshore reefs (Tokomaru Rock, Hawea Rock, Temoana Rock) at the seaward end of the port navigation channel. Incoming waves are locally focused onto the rocks and slow down due to the shallow rough bathymetry. Wave crests also shoal when interacting with the offshore reefs, resulting in the wavelength decreasing, and the height increasing due to the sudden change in depth. This can result in the wave train splitting from a continuous swell, to separate swells that travel towards the shore in slightly different directions according to the nearshore contours either side of the rocks. Waves shoaling over rocks also results in a larger wave crest with a notable peak. Landward of the offshore rocks, swell waves that were split by the reefs are directed towards each other and can converge to form a peak at the Pipe surf break which the break is well known for having. This separation of uniform swell into split swells also influences wave approach to Roberts Road. The influence of offshore reefs in preconditioning waves before breaking is considered a primary reason why the Pipe surf break offers a reliably peak that allows high performance surfing.

The converging and peaked wave pattern created by offshore reefs influences where and how waves break. This creates feedback, where the wave breaking location influences the formation of nearshore bars and rips, which in turn influence how and where waves break. This feedback helps to create a regular peak at the Midway ('Pipe') break. Therefore, any modification to the sediment supply, offshore wave energy or nearshore wave preconditioning could influence the surfing experience at Pipe and Roberts Road.

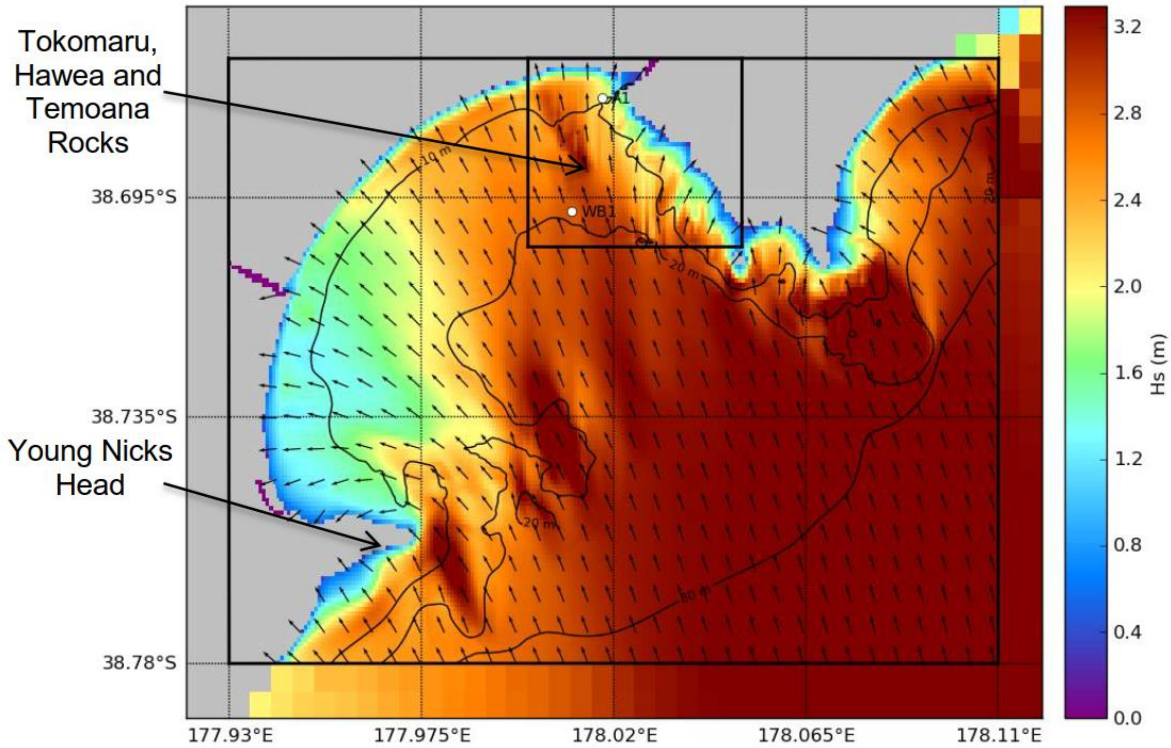


Figure 4-1: Example of wave height distribution from a large southerly wave event on 29 July 2012 (source MetOcean, 2017).

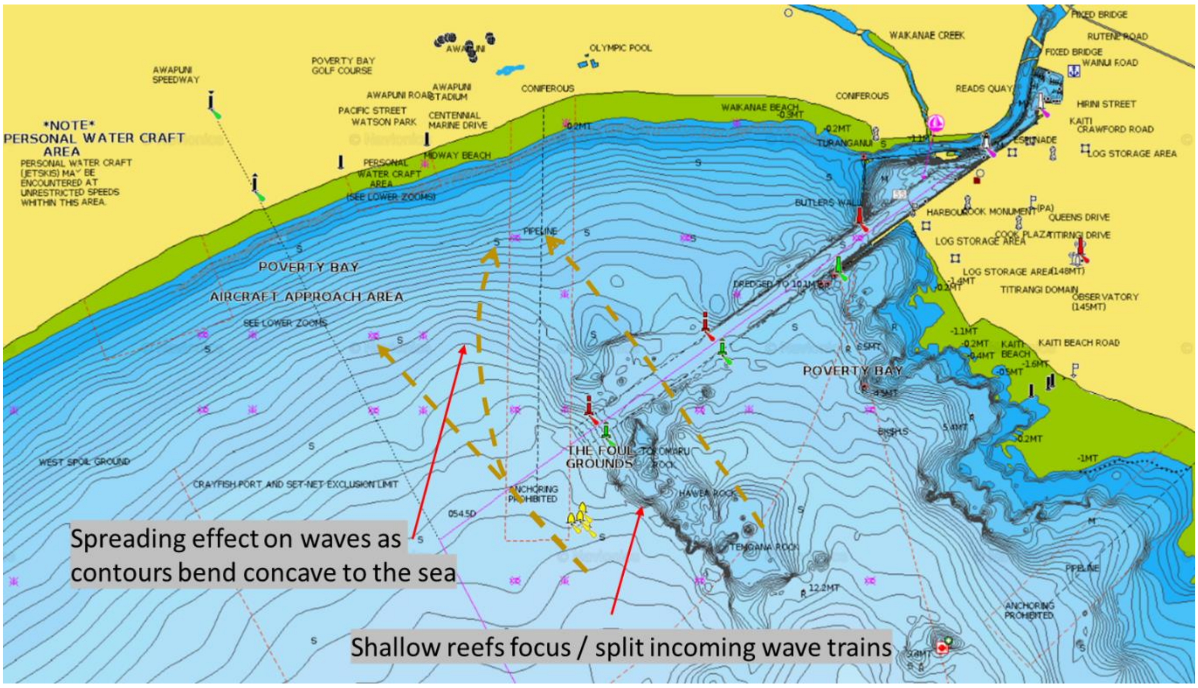


Figure 4-2: Annotation of bathymetric features offshore Pipe and Roberts Road that influence wave form and preconditioning. (Base map from Navionics ChartViewer)

4.2 Potential effects of proposed Eastland Port works

4.2.1 Incoming swell energy

In terms of influencing incoming wave energy, the proposed dredging works, dredge disposal, and reclamation are not expected to have any impact on the offshore wave height or period seaward of the entrance channel. The influence of dredging the entrance channel is assessed in the wave form section.

4.2.2 Incoming wave form

Incoming wave form encompasses the how offshore waves are influenced and preconditioned by nearshore bathymetry to result in a wave breaking style that is good for surfing. A comprehensive assessment was undertaken by MetOcean (2021) to understand how the change in bathymetry associated with the proposed dredging and reclamation will influence wave form and preconditioning at Pipe and Roberts Road. The main change that could potentially influence surf breaks at Pipe and Roberts is the deeper port navigation channel, which is within the swell corridor for these breaks. The typical change in bed level at the port navigation channel is -0.6 m (MetOcean, 2021).

The influence of offshore reefs on surf breaks at Pipe and Roberts Road is evident in the MetOcean (2021) modelling simulations (Figure 4-3). This provides confidence that the SWASH model used by MetOcean is capable of resolving the preconditioning processes of shoaling, refracting, splitting and focusing that influence the quality of surfing waves at Pipe and Roberts Road. MetOcean (2021) present a systematic comparison of wave patterns associated with different wave directions that were repeated for the existing bathymetry and the post works bathymetry (Figure 4-4). MetOcean (2021) present a direct comparison of wave height for the existing situation and post completion of the dredging and reclamation works (Figure 4-5 and Figure 4-6) that they use to assess the potential effect of the proposed works on surfing waves. MetOcean (2021) conclude that the modelling work did detect a difference in wave height following the dredge deepening and show that this difference is generally less than 2%.

The key physical process that being modified by the proposed works is that the deeper channel will subtly influence wave refraction across the channel. Waves travel faster deeper water and refraction occurs when a wave train travels across varying depths, with a change in angle associated with one section of the wave being in deep water and another in shallow water. Therefore, the deeper channel could result in slightly different wave angles on the landward side of the channel compared to the existing situation, but this will only occur when waves cross over channel at an angle. Therefore, waves approaching from the south will be modified differently compared to waves approaching from the southeast. The change in wave angle leeward of the channel or at the breakpoint was not assessed by MetOcean. To cover this in the assessment here, the wave profile outputs from MetOcean were digitally annotated using a scaled ruler to compare the angles between the pre and post works outputs. Results indicate that wave angle landward of the channel modified by ±1 degree with a deeper channel, which results in a ±2-degree change in wave direction at breaking. This difference in wave angle is considered low and is unlikely to result in a noticeable impact to surfing. Further, the interference pattern in the MetOcean output figures showing a cross hatched pattern at Midway is consistent in the pre and post works simulations which indicates that the pre-conditioning process will be similar following channel deepening.

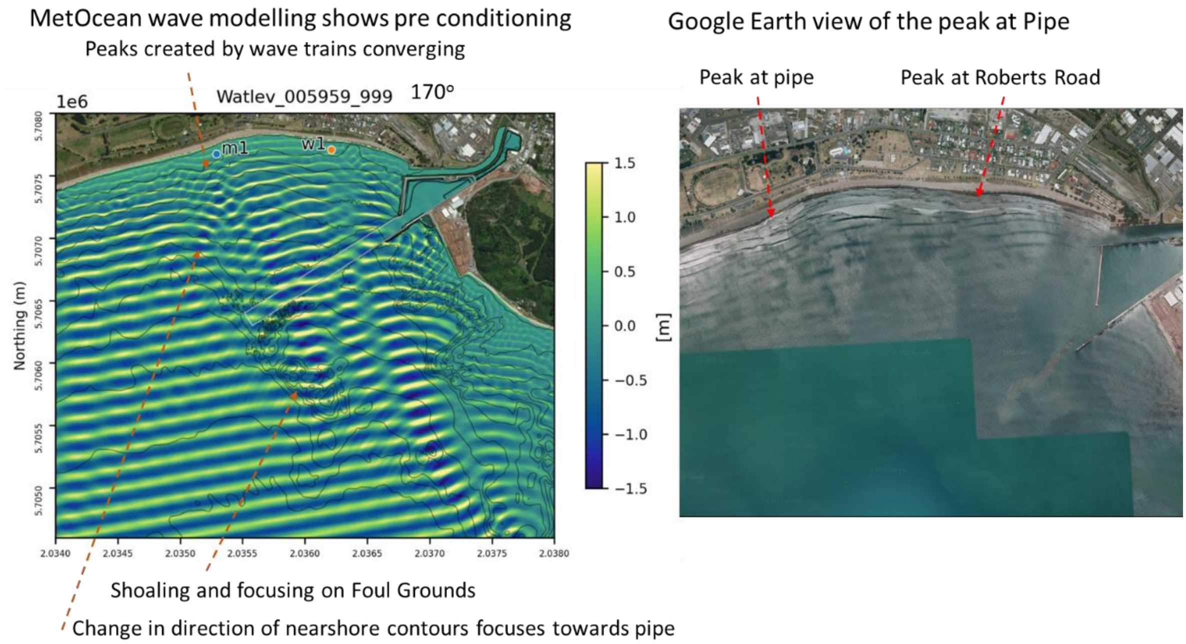


Figure 4-3: Example of MetOcean (2021) SWASH model showing wave focusing, shoaling, and splitting at offshore reef locations and a Google Earth image showing similar peaks in the surf zone.

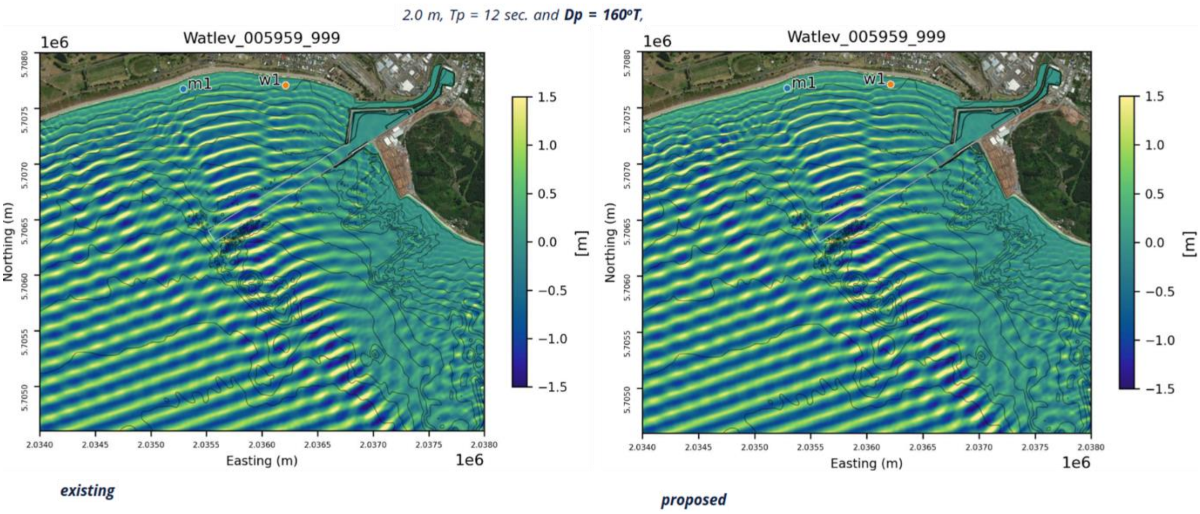


Figure 4-4: Example of MetOcean (2021) simulations with the existing and adjusted bathymetry for the 160^o scenario.

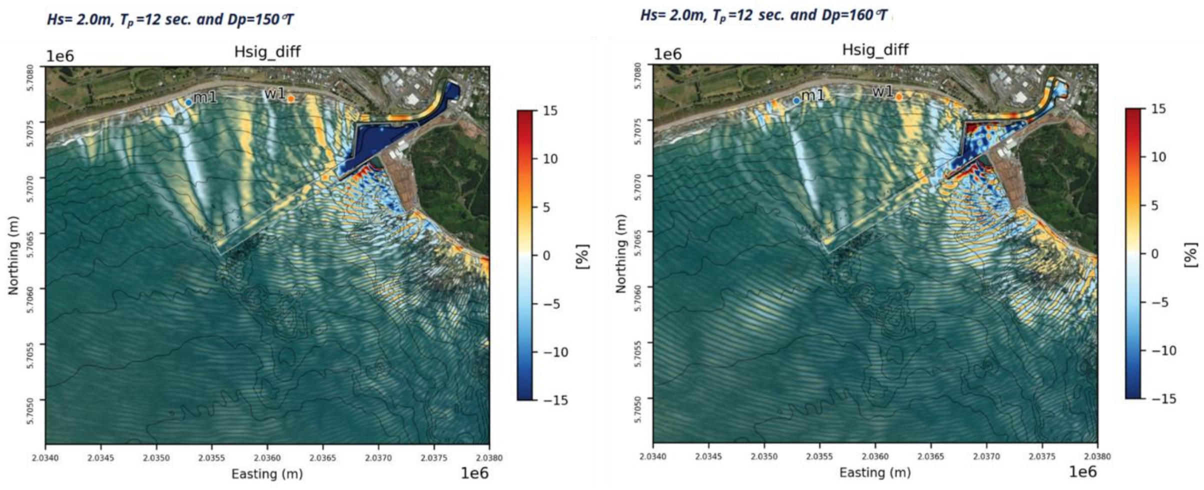


Figure 4-5: Percentage difference in wave height for the 150° and 160° simulations (adapted from MetOcean 2021).

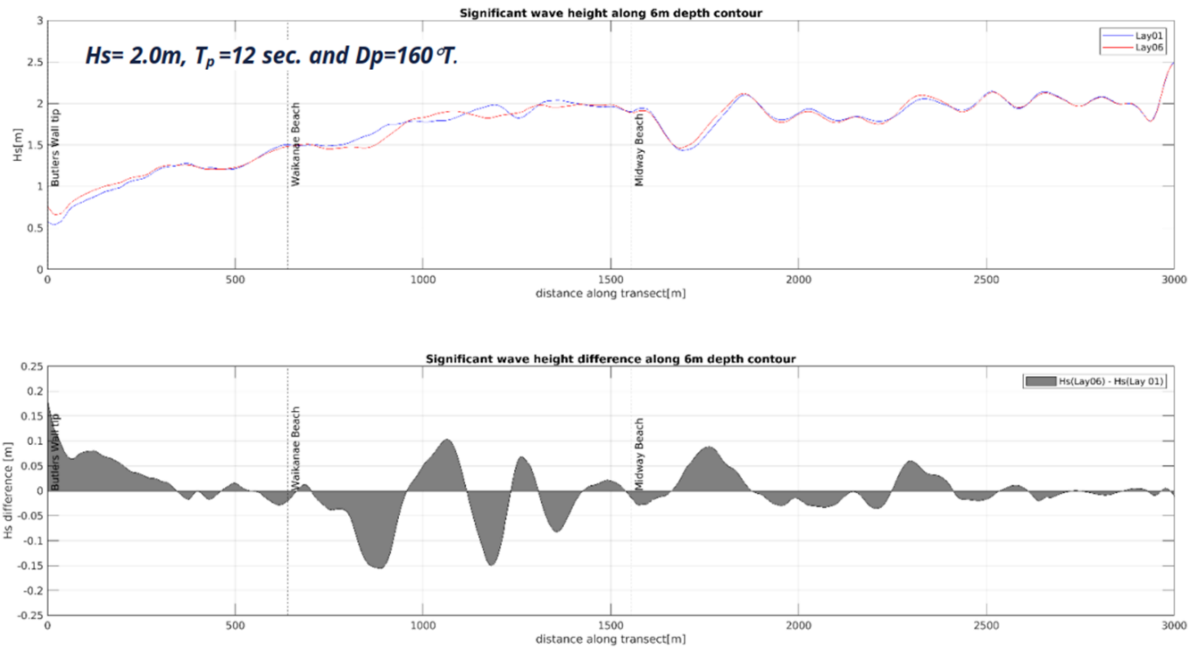


Figure 4-6: Long-section of wave height at the 6 m depth contour showing significant wave height for the pre and post works scenario and the residual in the lower panel (adapted from MetOcean 2021).

MetOcean (2021) modelling results were interpreted to assist with understanding the likelihood and consequence of dredging on the surf breaks at Roberts Road and Pipe. Results show that the proposed dredging will have a small impact on surf breaks at Midway Beach (Pipe) and Roberts Road/Waikanae:

- Average difference in wave height at the Midway transect was 0.04 m (slightly larger post dredging).
- Maximum difference in wave height at the Midway transect was 0.25 m (increase post dredging), associated with an offshore wave direction of 160°.
- Average difference in wave height at the Roberts Rd/Waikanae transect was 0.04 m (slightly larger post dredging).

- Maximum difference in wave height at the Midway transect was 0.04 m (increase post dredging), associated with an offshore wave direction of 160°.
- The largest reduction in wave height (averaged across the transect) was -0.14 m, at Midway, for the 170° angle.

Based on the modelling work by MetOcean and our interpretation of wave angles, it appears that the effect of proposed port works on surfing wave form at Pipe and Roberts Road will be low/minor.

4.2.3 Breaking location / style

The change in wave breaking location was not presented in the MetOcean (2021) surfing wave assessment. Breaking style and location is partly influence by wave height, which MetOcean do show will not be discernibly different after the dredging works. Therefore, breaking location and style is unlikely to be modified because of changes in wave height. Adjustments to the wave direction and pre-conditioning can also result in changes to the breaking location and style. The change in refraction behaviour due to the deeper channel is expected to be minimal (1-2 degrees), which could have a small influence on wave breaking, but this is not expected to be discernible to a regular surfer at Pipe or Roberts Road. Further, the works are not located within the surf break area so will have no direct influence on the wave breaking process.

The breakpoint location and style is also influenced by nearshore bathymetry, that is constantly shifting around in sedimentary systems like the Waikanae and Midway coast. Nearshore sand bars directly influence where waves break but nearshore bars are also formed by nearshore wave processes (this is called a morphodynamic feedback, where bedforms and processes are coupled). The peaking waves at Pipe and Roberts Road form because of preconditioning by offshore reefs that help for create semi-consistent sand bars that reinforce the potential for a peeling ride. Therefore, any change to the preconditioning could have a morphodynamic feedback on sediment dynamics and nearshore bar formation. The small change in wave patterns presented in the MetOcean (2021) numerical modelling indicates that the deeper navigation channel is unlikely to have a discernible influence on nearshore bar dynamics.

Long term changes to the breaking location and style of a surf break can occur if natural sediment transport processes are interrupted because of development. Sediment inputs to the Midway and Waikanae section of coast are from the Turanganui River and the Waipaoa River. Both rivers have existing training works that have been in place for several decades and the proposed works will not interrupt this supply of sediment. The Turanganui River was separated from the port in the 1920s and the proposed dredging of the entrance channel is not expected to influence sediment transport form the river mouth to the coast.

In summary, the effect of proposed dredging and reclamation on wave breaking location and form is considered low.

4.2.4 Smoothness of wave face

Wave face smoothness can be impacted if there are changes to reflection or currents. The proposed works are seaward of the surf zone and are not expected to have any discernible effect on the ride smoothness.

4.2.5 Ride line/length

The ride length can be impacted if a development occurs directly in the surf-zone. For example, breakwaters and boat ramps have been constructed at point breaks at Manu Bay (Raglan) and Point Annihilation (Mahia) that directly shorten the ride length. Direct changes to the surf zone bathymetry (e.g., a channel) could also change the ride line or length. The proposed works by Eastland Port are not expected to affect the ride line or length at Midway and Waikanae.

4.2.6 Currents

Nearshore currents in the surf zone influence sediment transport, morphological features (e.g., sand bars) and long-term beach evolution. Wave generated currents include longshore flow which occurs when waves approach the coast at an angle, and rip-cell circulation where water flows seaward between sand bars.

The predicted change in wave form approaching the coast is not expected to result in a discernible change in wave generated currents.

4.2.7 Access

The activity proposed by Eastland Port is limited to land operated by the port and the marine area seaward of the surf break area, and is therefore not expected to have any effect on:

- Access onto foreshore.
- Access along foreshore.
- Access into/out of surf.

4.2.8 Water quality

Poor water quality, including turbidity associated with dredge induced suspended sediments can negatively influence the surfing experience. In extreme cases, poor water quality can be a health hazard if toxins are present due to uncontrolled discharge.

The proposed dredging activity has potential to impact water quality by stirring up suspended sediment. Plumes of suspended sediment during dredge activity would be considered undesirable by surf break users. Suspended sediment from dredging and disposal activities was assessed by MetOcean (2018, 2018b) as part of the wider environmental effects assessment.

Several plume dispersion model outputs are presented in MetOcean (2018), showing the suspended sediment concentration associated with different dredge locations, and dredge vessels. Results show that dredge induced suspended sediment is relatively localised to the entrance channel and port. Results indicate that the suspended sediment concentration is maximum at the bed level and is highly dependent on the prevailing climate condition and dredge method. Higher concentrations and larger plume areas are associated with larger vessels that hold a greater volume, and when 'overflow' is allowed, where sediment spills off the boat into the water. However, results indicate that dredge induced suspended sediment does not reach the beach or surf zone and does not overlap with surf breaks. Therefore, the effect of dredging activities on water quality is considered low.

Suspended sediment from dredge disposal was assessed by MetOcean (2018b) using a numerical model. Results indicate that locally high suspended sediment concentrations occur at the seabed, within a radius that rarely exceeds 1,000 m. Suspended sediment at the surface is significantly lower in terms of concentration and rarely exceeds a radius of 250 m. The dredge disposal location is 3 km offshore of Pipe and Roberts Road at the closest point. Therefore, according to the assessment presented in MetOcean (2018b) the effect of dredge disposal on water quality at Waikanae and Midway is low.

This conclusion of a low effect is further supported by historic dredging activity and background levels of suspended sediment associated with river discharge and waves. Annual maintenance dredging and disposal (up to 140,000 m^3/yr) has been undertaken by Eastland Port in recent decades. The potential effect of suspended sediment on surf break water quality associated with the proposed future dredging and disposal is expected to be consistent with this existing baseline.

4.2.9 Summary of coastal processes and effects

It is important to recognise the potential effects in context of natural coastal processes that influence the surfing experience at Waikanae and Midway. The potential effects of deepening the entrance channel on surfing are considered low based on the changes in wave energy, form and breaking likely not being discernible to a regular surfer. The modelling used to inform this finding is based on idealised conditions that were used to compare wave processes before and after deepening the channel. In terms of coastal processes that influence surfing at Midway and Waikanae, pre-conditioning from offshore reefs is considered critical to creating a peak, which is especially noticeable at Midway (The Pipe break). The modelling by MetOcean shows that this preconditioning process is consistent between the existing channel and the slightly deeper channel. Further, natural coastal processes in the form of storms and episodic sediment movement results in an everchanging and dynamic environment in the nearshore where surfing takes place. While the preconditioning of waves by offshore reefs helps to create reasonable consistent sand bars, the natural environment is still highly variable and evolves in response to ocean and weather conditions at different timescales (e.g., storms, seasons, interannual climate patterns, climate change). The baseline state that these natural processes vary around is not expected to be modified because of the deeper entrance channel.

4.3 Risk rating

The assessment of potential effects on physical surfing elements was used to inform the consequence, likelihood and risk of the proposed port works on each surf break element (Table 4.1). The maximum consequence for individual elements was considered minor, and the maximum likelihood was considered unlikely. The overall risk of proposed port developments and dredging on surfing at Midway and Waikanae is considered low.

Table 4.1: Risk rating for Midway and Waikanae surf breaks

Physical elements defining the use and enjoyment of a surf break	Consequence	Likelihood	Risk
Incoming swell energy	Minor (4)	Highly unlikely (E)	Low
Incoming wave form	Minor (4)	Unlikely (D)	Low
Breaking location/style	Minor (4)	Unlikely (D)	Low
Smoothness of wave face	Minor (4)	Highly unlikely (E)	Low
Ride line/length	Minor (4)	Highly unlikely (E)	Low
Currents	Minor (4)	Unlikely (D)	Low
Access onto foreshore	n/a	n/a	Low
Access along foreshore	n/a	n/a	Low
Access into/out of surf	n/a	n/a	Low
Water quality	Minor (4)	Unlikely (D)	Low
Wairua/Landscape	n/a	n/a	n/a

5 Waipaoa River mouth ('Big River')

5.1 Coastal processes influencing surf breaks

The 'Big River' surf break is located at the mouth of the Waipaoa River, which is known to be a highly dynamic location where nearshore sand bars and spits are consistently shifting around in response to river flow events and coastal storms (Figure 5-1). The surf break is understood to work best during large east to southeast swell conditions and when there is a pronounced nearshore delta/bar extending offshore. This type of nearshore bar is most likely to form after high river flow conditions, when any spit features are breached and new shingle material is deposited offshore. Conditions that produce excellent surf at the Waipaoa River mouth are rare and require the right swell conditions to coincide with the right bar shape at the ever-changing river delta. The environmental and physical forces that result in good surfing at the Waipaoa River Mouth reflect high energy events and a very dynamic environment that is hard to predict.

Figure 5-1: Google Earth images showing the dynamic coastal environment at the mouth of the Waipaoa River.

5.2 Potential effects of works surf break

5.2.1 Incoming wave energy

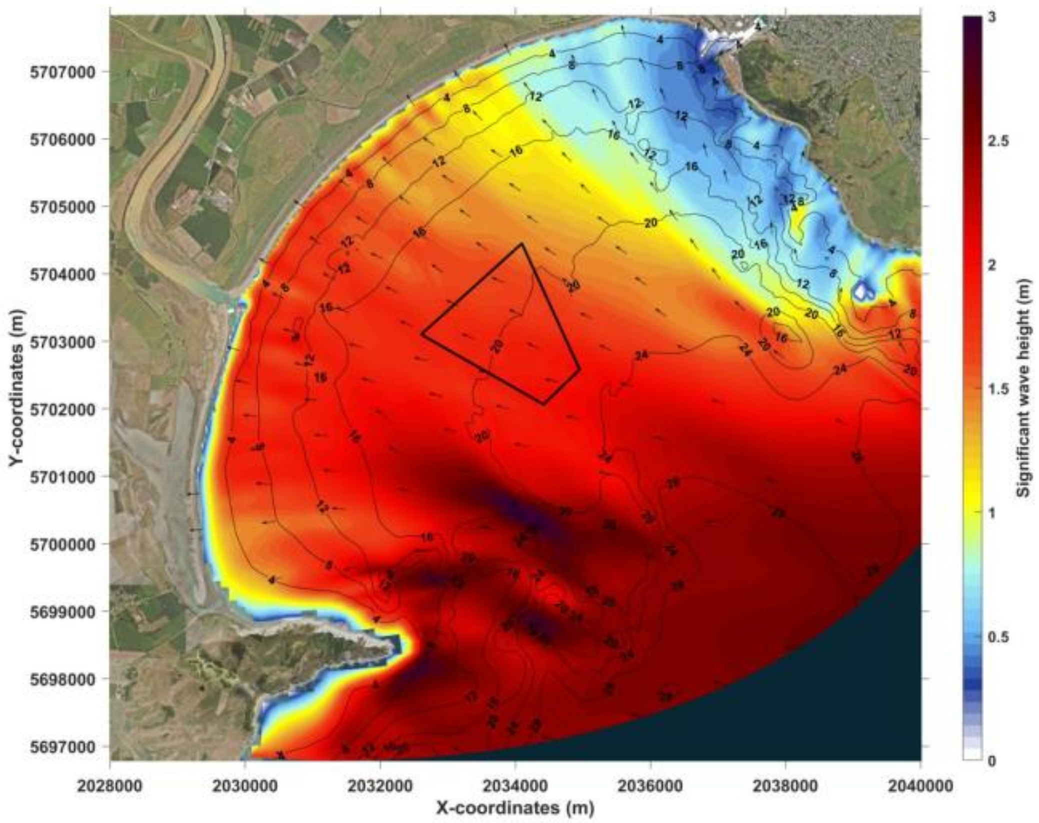
The break is sheltered from south swell due to Young Nicks Head and the shoreline orientation (ESE facing). The break is also partly sheltered from north-easterly waves by the headland and reefs around Tuaheni Point. The main wave direction for surfing at Big River is southeast, which occur for 45% of the time (MetOcean View output point 178.0500, -38.7400, NZ Wave Gisborne model).

The dredging disposal ground for Eastland Port (existing and proposed) are within the swell corridor for the Big River surf break. A potential effect of disposing material is that a mound could form and therefore change the bathymetry that influences wave energy approaching the break. This was assessed by MetOcean (2021), where the bed level of the disposal grounds was modified to include 140,600 m^3 of capital dredge material (0.049 m) and 140,000 m^3 of maintenance dredge material (0.052 m). The disposal grounds are located 2.3 km offshore of the Waipaoa River mouth at a depth of around 17 - 22 m, so the relative change in bed level is small.

Numerical modelling simulations were undertaken by MetOcean (2021) to qualify the impact of dredge disposal on wave energy reaching Big River for different optimal wave heights and directions. An industry standard spectral wave model was used for these simulations, which calculates wave height, period, direction, and energy but does not resolve individual wave patterns or form. An example is presented in Figure 5-2 showing the wave heights during a large easterly wave event (3.2 m waves from the east). The difference in wave height before and after dredge disposal is also presented in Figure 5-2 and indicates that the change in wave height is slightly higher directly leeward of the disposal grounds, and slightly lower lateral to the disposal grounds. However, the maximum difference in wave height (positive and negative) is less than 0.02 m across the range of conditions modelled by MetOcean.

MetOcean conclude that the effect of dredge disposal on wave energy reaching Big River is negligible. However, this is based on a single year of maintenance dredge deposition and does not account for the cumulative effect capital dredging plus annual maintenance dredge deposition over the consent lifetime. MetOcean (2021b; 2021c) do assess the morphological response of disposed material in a separate report and show approximately 71 – 80% of deposited material is remobilised out of the dredged disposal ground and transported around the wider nearshore embayment. Therefore, we can extrapolate their results to identify a potential cumulative change in depth over 10 years (assuming 30% retention in the disposal grounds), which is below 0.2 m. Without additional modelling to confirm this extrapolation, the cumulative increase in bed level is still unlikely to have a discernible impact on wave energy reaching the Waipaoa River mouth.

Sedimentation within Poverty Bay is also influenced by suspended sediment from the Waipaoa River, which supplies approximately 12.9 Mt of sediment into the bay per year (Shand, 2017). An assessment by MetOcean (2021e) suggests that the effect of dredge disposal on sedimentation offshore of Big River is negligible in comparison to the input from the Waipaoa River.



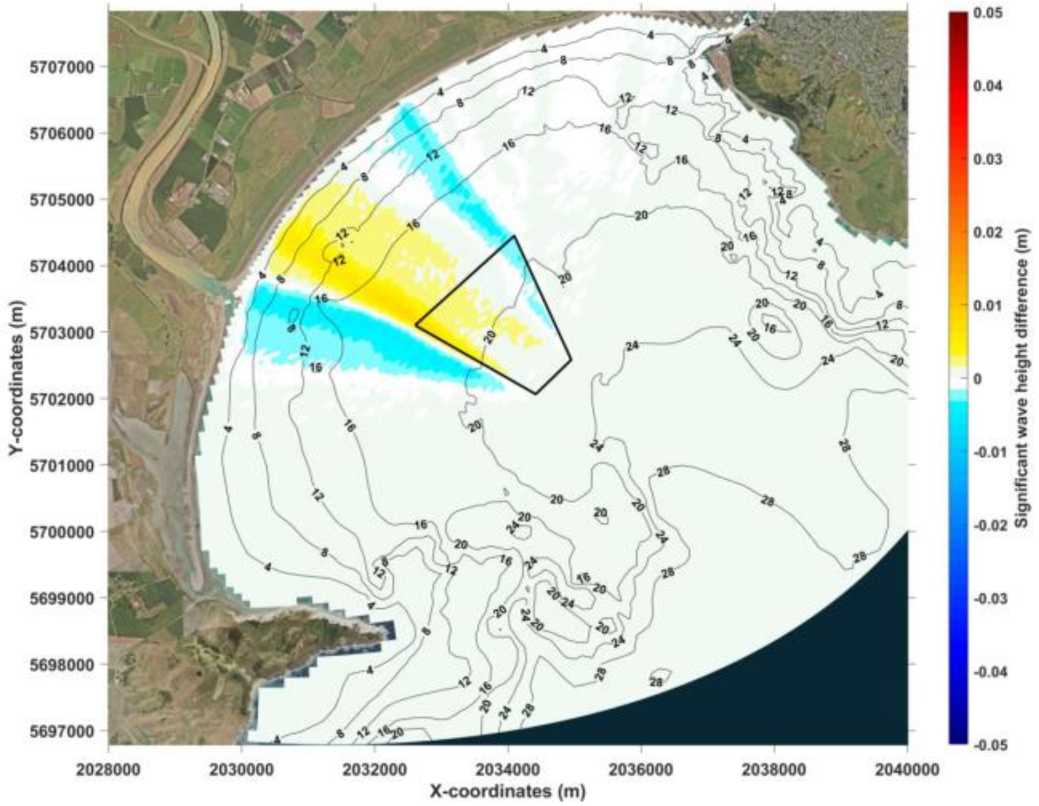


Figure 5-2: Wave modelling results for Big River from MetOcean (2021) showing the initial wave height (top) and the difference in wave height following dredge deposition (bottom).

5.2.2 Incoming wave form

Wave form refers to how waves approaching a surf break are 'preconditioned' by nearshore bathymetric features before breaking. This could include refraction around a headland, shoaling over a reef, or diffracting around an island. In the case of Big River, wave form is largely influenced by the nearshore seabed at the delta, which is sedimentary and dynamic. No large-scale features are present in the deeper nearshore bathymetry offshore of the surf break at Big River to precondition waves, and the morphology of the Waipaoa River delta is expected to have the largest influence on wave form and breaking. It is unlikely that wave form at Big River will directly be affected by the proposed dredge disposal in a notable way.

Indirect changes to the wave form could occur if the offshore disposal site has a significant influence on wave energy reaching the surf break. Modelling analysis by MetOcean (2021) indicate that there will be no significant difference in wave energy due to the disposal mound, and therefore there is unlikely to be a discernible effect on wave form.

5.2.3 Breaking location and style

The breaking style and location at Big River is known to be highly variable and dynamic. Optimal conditions appear to follow large river discharge which can occasionally deposit shingle sediment in the form of a bar that is angled towards the shoreline (Morse and Brunskill, 2004). The shape of nearshore bars at Big River is therefore highly dynamic and influenced by rainfall and sedimentation in the wider catchment. Coastal spit features also influence the nearshore and beach morphology which influences wave breaking, which can be seen in Figure 5-1 from different Google Earth images. Based on the highly dynamic nature of the spits and river mouth delta, and the inconsistent breaking zone, it is unlikely that the works proposed by Eastland Port will have a detectible impact on breaking location and style.

5.2.4 Smoothness of wave face

The dredge disposal grounds is not expected to change the wave energy, wave form or wave driven currents in any way that could affect the smoothness of the wave face.

5.2.5 Ride line and length

The dredge disposal grounds is not expected to change the wave energy, wave form or wave driven currents in any way that could affect the ride line or ride length.

5.2.6 Currents

The dredge disposal grounds is not expected to change the wave energy, wave form or sediment dynamics in any way that could affect surf zone currents.

5.2.7 Access

The activity proposed by Eastland Port is limited to land operated by the port and the marine area seaward of the surf break area, and is therefore not expected to have any effect on:

- Access onto foreshore.
- Access along foreshore.
- Access into/out of surf.

5.2.8 Water Quality

Poor water quality, including turbidity associated with dredge induced suspended sediments can influence the surfing experience. In extreme cases, poor water quality can be a health hazard if toxins are present due to uncontrolled discharges.

The proposed dredging activity has potential to impact water quality by stirring up suspended sediment. Plumes of suspended sediment during dredge activity would be considered undesirable by surf break users. Suspended sediment from dredging and disposal activities was assessed by MetOcean (2018, 2018b) as part of the wider environmental effects assessment.

Several plume dispersion model outputs are presented in MetOcean (2018), showing the suspended sediment concentration associated with different dredge locations, and dredge vessels. Results show that dredge induced suspended sediment is relatively localised to the entrance channel and port. Results indicate that the suspended sediment concentration is maximum at the bed level and is highly dependent on the prevailing climate condition and dredge method. Higher concentrations and larger plume areas are associated with larger vessels that hold a greater volume, and when ‘overflow’ is allowed, where sediment spills off the boat into the water. However, results indicate that dredge induced suspended sediment does not reach the beach or surf zone and does not overlap with surf breaks. Therefore, the effect of dredging activities on water quality is considered low.

Suspended sediment from dredge disposal was assessed by MetOcean (2018b) using a numerical model. Results indicate that locally high suspended sediment concentrations occur at the seabed, within a radius that rarely exceeds 1,000 m. Suspended sediment at the surface is significantly lower in terms of concentration and rarely exceeds a radius of 250 m. The dredge disposal location is 2.3 km offshore of the Waipaoa River mouth at the closest point. Therefore, according to the assessment presented in MetOcean (2018b) the effect of dredge disposal on water quality at Big River is low.

This conclusion of a low effect is further supported by historic dredging activity and background levels of suspended sediment associated with river discharge and waves. Annual maintenance dredging and disposal (up to 140,000 m^3/yr) has been undertaken by Eastland Port in recent decades. The potential effect of suspended sediment on surf break water quality associated with the proposed future dredging and disposal is expected to be consistent with past activities. The attribution of suspended sediment to disposal activity is also complicated by the high background levels of suspended sediment from the Waipaoa River that releases 12.9 Mt of sediment per year. Since optimal surf conditions occur following high flow events, it is likely that suspended sediment concentrations from the river will be high anyway.

5.2.9 Summary of coastal processes and effects

The Waipaoa River mouth is a highly dynamic delta system that is influenced by high energy river flows and wave processes. The dominant processes that lead to good surfing conditions are understood to follow river flow events that deposit shingle sediment in the nearshore and reshape the mouth morphology to have a bar that is angled to the shoreline. The interaction of waves with the nearshore delta then determines the short-term evolution of nearshore morphology and potential for surfing. The potential effects of dredge disposal on wave energy, wave form, and breaking style are considered low for surfing at Big River based on the small differences detected in modelling investigations by MetOcean. This identification of a low effect is supported by the natural dynamics that occur at the Waipaoa River mouth, which control the morphodynamic processes that can result in good surfing conditions. In comparison to the small influence of dredge disposal on surfing at Big River, the natural coastal processes that shape this system have a critical influence on surfing and will not be changed by the proposed works. The risk of the dredge disposal ground growing to a level to that influences incoming wave energy or form at Big River is low based on modelling results from MetOcean. Further, natural input of sediment from the Waipaoa River to Poverty Bay adds a significantly volume of material to Poverty Bay compared to dredge disposal (MetOcean 2021e).

5.3 Risk ratings

The assessment of potential effects on physical surfing elements was used to inform the consequence, likelihood and risk of the proposed port works on each surf break element (Table 5.1). The maximum consequence was for individual elements was considered minor, and the maximum likelihood was considered unlikely. The overall risk of proposed port developments and dredging on surfing at Big River is considered low.

Table 5.1: Risk rating for Waipaoa River mouth (Big River)

Physical elements defining the use and enjoyment of a surf break	Consequence	Likelihood	Risk
Incoming swell energy	Minor (4)	Unlikely (D)	Low
Incoming wave form	Minor (4)	Unlikely (D)	Low
Breaking location/style	Minor (4)	Unlikely (D)	Low
Smoothness of wave face	Minor (4)	Highly unlikely (E)	Low
Ride line/length	Minor (4)	Highly unlikely (E)	Low
Currents	Minor (4)	Unlikely (D)	Low
Access onto foreshore	n/a	n/a	Low
Access along foreshore	n/a	n/a	Low
Access into/out of surf	n/a	n/a	Low
Water quality	Minor (4)	Unlikely (D)	Low
Wairua/Landscape	n/a	n/a	n/a

6 Monitoring and Consent Conditions

Monitoring is an important part of any activity that requires resource consent. Proposed monitoring requirements are presented in MetOcean (2021f), which include regular surveying of the dredging area and the disposal grounds.

For the dredging activity, MetOcean (2012f) recommend:

1. Annual to bi-annual hydrographic surveys of the channel and swinging basin.
2. Hydrographic, shore normal transects aligned with the Gisborne District Council beach profiles inshore of the Shipping Channel to be completed at time of the Annual to bi-annual hydrographic surveys.
3. Records of dredging operations are to be maintained, including start/stop locations of dredging and approximate unconsolidated volume of sediment dredged.

For the dredge disposal activity, MetOcean (2012f) recommend:

1. Annual to bi-annual hydrographic surveys of the disposal ground.
2. Hydrographic, shore normal transects aligned with the Gisborne District Council beach profiles inshore of the disposal ground to be completed at time of the Annual to bi-annual hydrographic surveys.
3. Records of dredging operations are to be maintained, including disposal locations.
4. Annual to every 2-year surficial sediment sampling of the disposal ground and control sites should be undertaken, consistent with the sampling undertaken in 2017.
5. Hydrographic surveys of a control area to compare rates of baseline sedimentation in the Poverty Bay to sedimentation at the disposal grounds.
6. Comparison analysis of hydrographic surveys with trigger points for more detailed analysis if three or more consecutive hydrographic surveys of the disposal ground show inconsistencies with the control site in terms of morphological evolution.

No surf break specific monitoring is presented in MetOcean (2012f). Most of the monitoring proposed in MetOcean (2021f) will be helpful for understanding effects of the proposed works on wave energy and form but will be less useful for assessing breaking location and style. However, this is likely appropriate given the influence that incoming wave form has on breaking at Waikanae and Midway Beaches and also given the finding of this assessment that the proposed works pose a low risk of adversely affecting the surf breaks within Poverty Bay.

7 Conclusion

Eastland Port are seeking resource consent to undertake capital dredging to deepen the port entrance channel and to maintain this deeper level with annual maintenance dredging, and to dispose of this material offshore. The scope of this risk assessment was to review technical information related to the proposed works, local coastal processes, and surf breaks, and to assess risk to surf breaks based on national guidance on surf break management.

An initial screening phase was used to identify that surf breaks at Waikanae Beach, Midway Beach and the Waipaoa River mouth could potentially be affected because the port dredging activities are located with the swell corridor. For Midway and Waikanae, waves pass over the port entrance channel before breaking. For the Waiapoa River mouth, waves pass over the dredge disposal grounds before arriving at the surf break. Surf breaks to the east of the port, including The Cliff, Sponge Bay and The Island were considered to be low risk because the breaks are on rock, or reef and the port works are located outside the swell corridor for these breaks. Therefore, a detailed assessment was undertaken specifically for the Waikanae and Midway section, and the Waipaoa River mouth.

The assessment method was based on identifying the physical elements that define the use and enjoyment of the surf breaks and assessing the potential impacts of the proposed port activity and the likelihood and consequence of any effect on each element. A framework outlined in a national guidance document was used for this assessment (Atkin et al., 2018). A risk matrix based on the identified likelihood and consequence was used to identify a risk rating that exists on a continuum from low to catastrophic.

The risk assessment was informed by systematically assessing how the proposed works will adjust physical properties of each surf break. The key physical changes to waves were assessed by interpreting modelling outputs from MetOcean (2021), which identified a ± 2% change in wave height along Midway and Waikanae, and a 0.2% change in wave height at the Waipaoa River mouth. At all breaks (Midway, Waikanae and Waipaoa River mouth), the maximum consequence for individual surfing elements was *minor*, the maximum likelihood was *unlikely* and the overall risk of the proposed activity on surfing is considered *low*.

8 Applicability

This report has been prepared for the exclusive use of our client Eastland Group Limited, 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 for resource consent and that Gisborne District Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Dr Eddie Beetham	Dr Tom Shand
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