Review of West Coast Region Coastal Hazard Areas

Version 2

Prepared for West Coast Regional Council

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Climate, Freshwater & Ocean Science

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Revision	Description	Date
Version 1.0	Draft report	28 June 2012
Version 1.1	Finalised report with minor updates	15 August 2012
Version 1.2	Updates to CHA20 (Taramakau) extent and text	29 January 2014
Version 1.3	Review of CHA's in areas with significant new development pressures including: North of Waimea Creek (CHA20), 3 Mile (CHA21), Mananui (outside of CHA21) and Neils Beach (new CHA26).	16 December 2015
Version 2.0	Reviewed low ranked CHAs 4, 8, 11, 15, 23 and 24 following damage observed during ex-cyclone Fehi and Gita. Also updated report to new NIWA format and updated references to relevant guidance documents etc. Added emphasis to highlight that prioritisation considers assets at risk as well and not just hazard severity.	4 May 2021
Version 2.1	Updated with feedback from WCRC and amended in line with detailed hazard mapping study of priority CHAs undertaken for the Te Tai o Poutini Plan	8 December 2021
Version 2.2	Minor updates/corrections following feedback from WCRC	14 February 2022

Quality Assurance Statement		
	Reviewed by:	Dr D. Murray Hicks
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Executive summary

The West Coast Regional Council (WCRC) is undertaking a review of its Regional Coastal Plan, which was made operative in 2000. As part of this, WCRC is taking the opportunity to review the 18 Coastal Hazard Areas (CHAs) identified in Schedule 3.3 of the Regional Coastal Plan.

The scope of the CHA review involves determining:

- Whether the current CHAs should stay the same (that is, if there are no changes to the area or the hazard risk);
- Whether any of the CHAs need to be removed (that is, if there is no longer a hazard threat), or changed in size or location;
- Whether any new hazard areas need to be added; and
- If possible, whether the hazard risk is low, medium or high, having regard to the criteria in Policy 24 on the New Zealand Coastal Policy Statement 2010.

This report details the outcomes of this CHA review, undertaken using a combination of literature review and virtual and actual site visits. 26 CHAs are recommended, which include some existing CHAs, some new CHAs, and some where boundaries (lateral extent along the coast) have been altered.

CHAs have been identified and prioritised based on a risk assessment which considers not only the level of hazard, but also assets at risk. Extensive stretches of the West Coast which experience high levels of hazard from erosion and flooding have not been included in CHAs because they have no/few assets at risk. Similarly, CHAs may be given low priority because of the small amount of at-risk assets, even though the hazards are severe.

A summary list of the CHAs described in this report is given overleaf. For each CHA a table is included in the main report with details of: the CHA location, assets at risk in the CHA, hazard processes affecting the CHA , factors influencing the priority assessment, existing management of hazards in the CHA, relevant references, recommendations for further analysis of the hazard and other notes. Specific recommendations for further investigation of hazards are given for all the high priority and some of the medium priority CHAs.

This CHA review was originally carried out in 2012 but has been updated in 2014, 2015 and 2021. Detailed hazard mapping for several CHAs was underway in December 2021 for the Te Tai o Poutini Plan and will provide more detail on the hazard processes, degree of hazard, and inland extent of hazard areas for those CHAs.

Table 1-1: Summary of West Coast coastal hazard areas. Further details on each CHA area available in Section 3 of this report.

CHA	Location	Priority	Status in 2012	Updates since 2012	Recommendations
CHA 1	Karamea	Medium	Existing		
CHA 2	Mokihinui	Medium	Existing		
CHA 3	Hector, Ngakawau and Granity	High	Existing		
CHA 4	Orowaiti Lagoon	High	New	May 2021	
CHA 5	Carters Beach	Medium	New		Monitor erosion rates
CHA 6	Omau	Medium	New		Monitor cliff retreat
CHA 7	Tauranga Bay	Low	Existing		
CHA 8	Nine Mile Beach	Low	Existing (split)	May 2021	
CHA 9	Little Beach	Medium	Existing (split)		
CHA 10	Woodpecker Bay	Medium	Existing	May 2021	
CHA 11	Maungahura Point to Meybille Bay	Low	New	May 2021	
CHA 12	Punakaiki Village (Pororari Beach)	High	Existing	May 2021	Monitor beach profiles and seawall condition
CHA 13	Punakaiki River Beach	Medium	Existing		
CHA 14	Pakiroa (Barrytown) Beach	Medium	Existing		
CHA 15	17 Mile Bluff to 10 Mile Creek	Low	Existing	May 2021	
CHA 16	Rapahoe	High	Existing		
CHA 17	Cobden	Medium	Existing (split)		Develop hazard zones
CHA 18	Blaketown to Karoro	Medium	Existing (split)		Monitor shoreline change Research effects of gravel mining and training walls
CHA 19	South Beach to Camerons	Medium	New		
CHA 20	Taramakau	Low	Existing	Jan 2014, Dec 2015	
CHA 21	Hokitika	High	Existing	Dec 2015	Develop hazard zones
CHA 22	Ōkārito	Medium	Existing	May 2021	
CHA 23	Hunts Beach	Low	Existing	May 2021	
CHA 24	Bruce Bay	Low	Existing		
CHA 25	Haast Beach to Waiatoto	Medium	Existing	Extended & renamed Dec 2021	
CHA 26	Neils Beach to Jackson Bay	Medium	N/A	Added Dec 2015, Extended and renamed Dec 2021	

1 Introduction

The West Coast Regional Council (WCRC) is undertaking a review of its Regional Coastal Plan (made operative in 2000). As part of this review, WCRC is taking the opportunity to review the eighteen Coastal Hazard Areas (CHAs) identified in Schedule 3.3 of the Plan. The CHAs identify areas on the foreshore that have adjoining land, property or structures of value to individuals or the community which are at risk of harm or damage from erosion, flooding, blow outs, or river migration. The existing CHAs were developed based on a 1992 report by John Benn and Don Neale, plus anecdotal knowledge.

In 2012 WCRC secured Envirolink funding (grants 1048-WCRC102 and 1069-WCRC106) to seek advice with regard to the CHA review. NIWA was subsequently contracted to undertake the review.

The review scope covers:

- Whether the current CHAs should stay the same if there are no changes to the area or the hazard risk;
- Whether any of the CHAs need to be removed if there is no longer a hazard threat, or changed in size or location;
- Whether any new hazard areas need to be added; and
- If possible, whether the hazard risk is low, medium or high, having regard to the criteria in Policy 24 on the New Zealand Coastal Policy Statement 2010 (see section 2).

The hazards within this scope of work are erosion, flooding, dune blow-outs and river mouth migration. Comments with regard to the effects of climate change, in particular changes in mean sea-level, are also given. Tsunami hazard was excluded from the scope of this review.

In 2015 further Envirolink funding was secured by WCRC (grant 1627-WCRC148) to review coastal hazards at particular areas of concern identified by Westland District Council. This report was updated in November and December 2015 to reflect the outcomes of this additional work.

In 2021 the report was updated further to reconsider hazards at CHAs 4, 8, 11, 15, 23 and 24 in light of damage observed during ex-cyclone Fehi in February 2018. References to national policy and sea level rise guidance documents was also refreshed to reflect updated guidance released between 2012 and 2021. Further updates to the report were carried out to highlight that the CHA priority assessment includes an assessment of assets at risk as well as hazard severity, meaning that low priority hazard areas may still have high hazard if there are only small numbers of assets at risk. These updates were funded by Envirolink grant 2132-WCRC197.

1.1 Methods

To carry out this review of CHAs in the WCRC's Regional Coastal Plan, we:

- Collated existing information on hazard-prone areas sent to us by Lillie Sadler of WCRC. This includes information such as:
  - Investigation/research reports done since 2000,

- Technical reports on individual Regional and District Council consent applications carried out in the last 10 years,
- News articles and photographs of flooding/erosion events,
- Other sources of information such as personal knowledge of west coast coastal issues, national guidance with regards to considering climate change effects at the coast, etc.;

- Undertook a site visit of the West Coast between Hokitika and Hector to inspect existing and potential CHAs;
- Completed a review of CHAs outside of that central area by way of a Google-Earth 'virtual' field trip; and
- Met with WCRC staff to discuss the scope of work and better understand the needs of WCRC with regard to the CHA review.

Some background information that provides context for this work is outlined in the next section of this report. We then provide a summary of our review of CHAs, including recommendations for new or changed CHAs and a first-pass prioritisation of risk level associated with these CHAs. Recommendations are also made for further work that might be required to better identify and manage coastal hazards on the West Coast.

2 Background

2.1 The New Zealand Coastal Policy Statement 2010

Since the existing Regional Coastal Plan was made operative in 2000, there has been a new National Policy Statement gazetted for the coastal environment. This, the New Zealand Coastal Policy Statement 2010 (NZCPS), requires councils to avoid increasing the risk of social, environmental and economic harm in recognised coastal hazard areas, and to encourage development that reduces the risk of hazard effects, and gives other direction on managing hazard risk. Regional policy statements, regional plans and district plans must give effect to the NZCPS. The NZCPS contains seven objectives and 29 policies. NZCPS objectives that are relevant to coastal hazards include:

- Objective 1 – *safeguarding the integrity, form, functioning and resilience of the coastal environment…by…maintaining or enhancing natural…physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature…*
- Objective 4 – *maintain and enhance public space…and recreation opportunities…by…recognising the potential for coastal processes, including those likely to be affected by climate change, to restrict access…and the need to ensure that public access is maintained even when the coastal marine area advances inland.*
- Objective 5 – *to ensure that coastal hazard risks taking account of climate change are managed by: locating new development away from areas prone to such risks; considering responses, including managed retreat, for existing development in this situation; and protecting or restoring natural defences to coastal hazards.*

A number of NZCPS policies are also relevant to coastal hazards, including:

- Policy 3 – Precautionary approach
- Policy 6 – Activities in the coastal environment
- Policy 7 – Strategic planning
- Policy 18 – Public open space
- Policy 19 – Walking access
- Policy 20 - Vehicle access
- Policy 24 – Identification of coastal hazards
- Policy 25 – Subdivision, use and development in areas of coastal hazard risk
- Policy 26 – Natural defences against coastal hazards, and
- Policy 27 – Strategies for protecting significant existing development from coastal hazard risk.

Of these, Policies 24-27 are the most pertinent to this review. Policy 24 in particular requires the identification of areas that are potentially affected by coastal hazards, and requires priority to be given to the identification of areas at high risk of being affected. Risks over at least 100 years are to be assessed, with regard to a number of factors such as:

- Physical drivers and processes including sea-level rise
- Short-term and long-term dynamic fluctuations of erosion and accretion
- Geomorphic character
- The potential for flooding
- Cumulative effects of sea-level rise, storm surge and wave height
- Human influences
- The extent and permanence of built development, and
- The effects of climate change.

The Department of Conservation (DoC) has developed guidance to help councils to implement the NZCPS (DoC 2011).NIWA has considered the requirements of the NZCPS in this review of CHAs, particular in regard to Policy 24 as required by the WCRC project scope, and by trying to bear in mind a 100-year timeframe for hazards.

As the NZCPS requires sea-level rise to be considered in assessing coastal hazards, a brief summary of climate change and sea-level rise science and management is given below.

2.2 Climate change and sea-level rise

Current guidance for the assessment of coastal hazards in New Zealand, considering the effects of Climate Change, is given in the report "Coastal Hazards and Climate Change: Guidance for local government" (MfE 2017a) and its accompanying summary document "Preparing for coastal change: a summary of coastal hazards and climate change guidance for local government" (MfE 2017b). A very brief overview is given here, focussing on sea-level rise projections.

Sea level rise science states that no single 'most likely' climate future can be determined and that hazard assessments must consider a range of possible sea level rise futures (MfE 2017). Four future greenhouse gas emission scenarios (known as "Representative Concentration Pathways or RCP's) are presented in the guidance to represent a range of possible sea-level rise futures for New Zealand (MfE 2017):

- a low to eventual net-zero emission scenario (RCP2.6);
- an intermediate-low scenario based on the RCP4.5 median projections;
- a scenario with continuing high emissions, based on the RCP8.5 median projections;
- a higher H+ scenario, taking into account possible instabilities in polar ice sheets, based on the RCP8.5 (83rd percentile) projections from Kopp et al (2014).

A long-term adaptive planning approach is recommended by the guidance, using the four recommended sea-level rise scenarios for hazard assessments. Given the anticipated long life of greenfield developments and major new infrastructure coupled with the requirements of the NZCPS to avoid future coastal risks over planning timeframes beyond 100 years, only the higher H+ scenario should be used for new developments. An overview plot of predicted sea level rise associated with the four scenarios is reproduced in Figure 2-1.

Recognising that an adaptive planning approach requires time to develop, the guidance provides minimum transitional allowances for sea level rise, for use in planning processes for four different categories of development prior to implementation of the recommended adaptive approach. The transitional allowances for different application are summarised in Table 2-1.

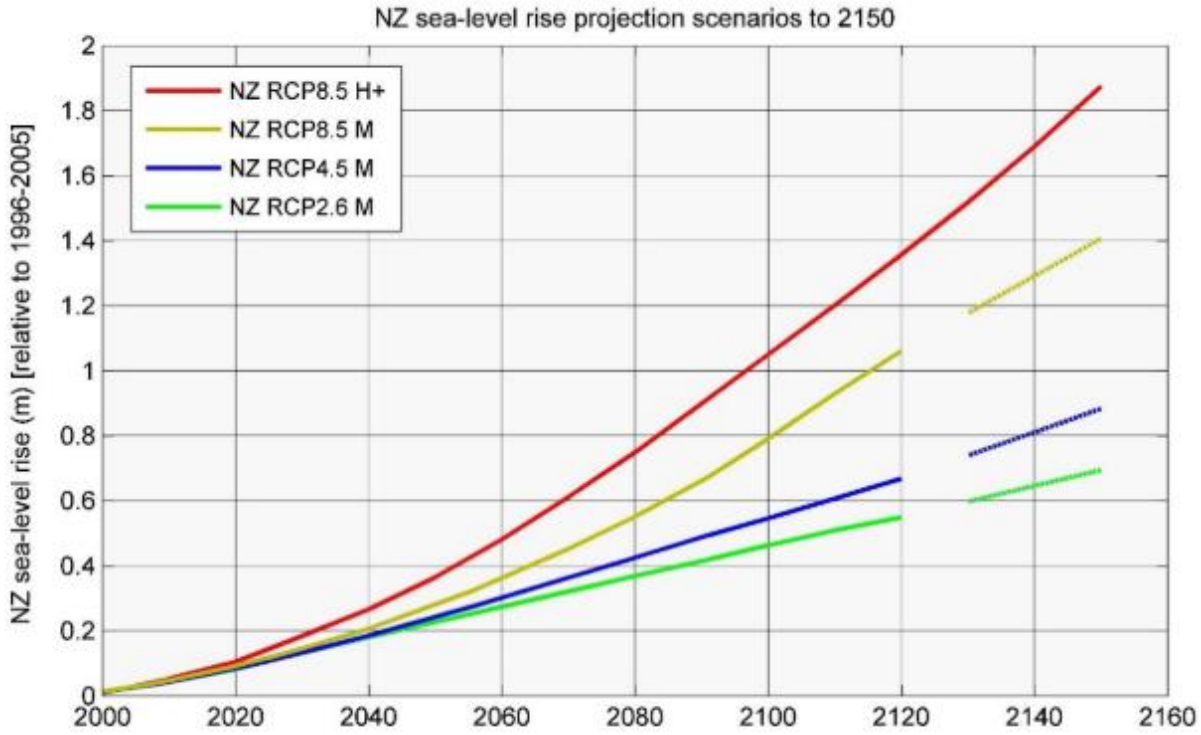


Figure 2-1: Four scenarios of New Zealand wide sea-level rise projections with extensions to 2150. Reproduced from Figure 27, MfE 2017a.

Table 2-1: Minimum transitional New Zealand wide sea-level rise allowances. Reproduced from Table 12, MfE 2017a.

Category	Description	Transitional response
A	Coastal subdivision, greenfield developments and major new infrastructure	Avoid hazard risk by using sea-level rise over more than 100 years and the H+ scenario
B	Changes in land use and redevelopment (intensification)	Adapt to hazards by conducting a risk assessment using the range of scenarios and using the pathways approach
C	Land-use planning controls for existing coastal development and assets planning. Use of single values at local/district scale transitional until dynamic adaptive pathways planning is undertaken	1.0 m SLR

Category	Description	Transitional response
D	Non-habitable short-lived assets with a functional need to be at the coast, and either low-consequences or readily adaptable (including services)	0.65 m SLR

The sea-level rise predictions presented in MfE 2017a and reproduced in Figure 2-1 and Table 2-1 are for the whole of New Zealand, but there are variations regionally due to rates of uplift and subsidence. There is little data available for West Coast specific sea-level rise predictions.

Sea-level rise is only one potential impact of climate change that may affect the coast. In addition we know:

- Temperature and precipitation will change (MfE 2008b).
- The intensity and frequency of storm events will change.
- This may lead to changes in storm surge and waves, and thus more frequent or higher magnitude flooding.
- This may also lead to changes in fluvial flooding (e.g., MfE 2010).

A summary of climate change projections for the West Coast region is provided on the MfE website (MfE 2018).

2.3 Ex-tropical cyclones Fehi and Gita

On 1 February 2018 ex-tropical cyclone Fehi moved into the North Tasman Sea and combined with a trough moving in from the southwest. Waves and storm surge, on top of a king tide, caused extensive coastal flooding and erosion throughout the West Coast. A state of emergency was declared in Buller District. Disruption to power, roading and communication occurred and up to 100 dwellings and business properties were rendered either permanently or temporarily uninhabitable.

On 20 February 2018 ex-tropical cyclone Gita caused further flooding and erosion, although generally its effects to the West Coast were not as severe as Fehi.

The wave climate on the West Coast is dominated by waves from the south west, driving sediment transport from south to north along the coast. During these cyclones waves occurred from the north, which in some locations resulted in unexpected and damaging impacts.

2.4 Approach used in this review

As discussed in Section 1, tsunami hazard is outside the scope of this review. In general, this review looks at coastal processes that lead to erosion, flooding, and migration of river mouths in particular. The coastal processes include the action of waves, tides and longshore currents on the movement of sediments along and perpendicular to the coast. For these natural processes to become hazards requires the addition of a person or thing (e.g., roading, residential properties) which has the potential to suffer harm as a result of those natural process acting upon it. In the context of this report, climate change including sea-level rise is a potential exacerbator of these hazards.

For this review we have focussed on the lateral extent of hazard areas along the coast. We have not considered 'zones' or 'setbacks', i.e., the landward extent of these hazard areas, as the scope of this review was to look at hazards in the Coastal Marine Area (CMA) only (up to MHWS). This is discussed further in Section 4.1 of this report.

We began by reviewing all of the literature received and mapping the geographic locations of the studies onto a GIS overlay of the CHAs. This allowed us to plan actual and virtual site visits of existing CHAs and areas where recent information has suggested coastal hazards exist. Based on literature evidence and observations from the field and virtual visits, we reviewed the existing CHAs and made recommendations either confirming existing CHAs, suggesting some new CHAs, or altering boundaries (lateral extent along the coast) of existing CHAs.

After mapping and recording the 'new' recommended CHAs, we applied a simple qualitative prioritisation of the hazard risk that they present (see Figure 2-1). This used 'expert opinion' to implement the simple definition that Hazard Process x Assets = Risk, or, in other words, the severity of hazard (likelihood) and the assets at risk (consequences) equal the risk. This prioritisation should be considered a 'first-pass' at identifying high, medium and low priority CHAs. The focus is on identifying high risk areas (NZCPS Policy 24) to allow for appropriate management of high risk areas and communities.

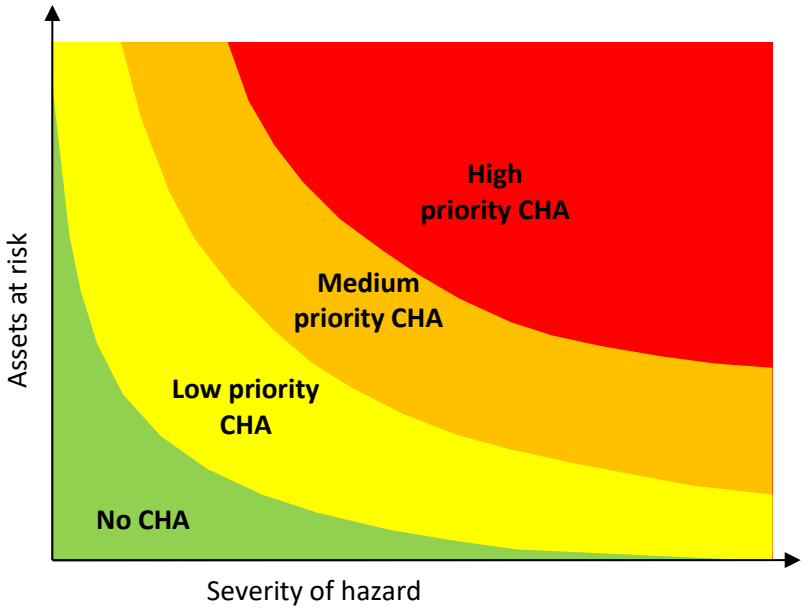


Figure 2-2: Schematic representing prioritisation process used in this report.

2.5 Risks to state highways

SH6 runs the length of the West Coast from Haast to Westport, with SH67 extending north from Westport to Karamea. These roads are key lifelines as they provide the only access to many communities along the coast. At many locations these key roads are exposed to risks of erosion and

flooding. Power and data cables follow the road closely in many locations and may also be vulnerable to erosion.

NZTA maintains the state highways and in many locations has constructed sea walls or other protection to defend the roads. The most vulnerable sections of highway are included in the CHAs identified in this report. When prioritising CHAs for further analysis of hazards we have focussed on areas with existing or proposed buildings vulnerable to coastal hazards. CHAs where state highways are the only significant asset have not been given high priority for further hazard analysis by WCRC.

CHAs where state highways are vulnerable to coastal hazards are:

- CHA1 Karamea
- CHA3 Hector, Ngakawau and Granity
- CHA4 Orowaiti Lagoon
- CHA10 Woodpecker Bay
- CHA11 Maungahura Point to Meybille Bay
- CHA12 Punakaiki Village (Pororari Beach)
- CHA13 Punakaiki River Beach
- CHA15 17 Mile Bluff to 10 Mile Creek
- CHA16 Rapahoe
- CHA19 South Beach to Camerons
- CHA24 Bruce Bay
- CHA25 Haast Beach to Waiatoto

3 Coastal Hazard Areas

In this section the coastal hazard areas (CHAs) identified as part of this review are detailed. For each CHA information is included on its:

- **Location:** Description including NZTM Topo50 grid references of the CHA start and end points, and a map.
- **Assets at risk:** brief description of key built assets at risk in the CHA including buildings, roads, airports and recreation facilities.
- **Hazard processes:** Description of hazard processes affecting CHA. The level of detail given depends on relevant references and on CHA priority. Hazard processes are defined under the categories of Erosion, Flooding, Dune blowouts and Down-drift effects. In general the most hazardous processes are listed first.
- **Priority assessment:** Low, Medium or High depending on the assets at risk and hazard process severity – see Section 2.3 for details on philosophy for prioritising CHAs.
- **Existing management:** Includes known existing coastal defences and other management practices affecting coastal hazards in the CHA.
- **Relevant references:** List of references to key reports and analysis of coastal hazards specific to the CHA. Other more general reports covering the whole coast or large sections of it are referenced in a bibliography (Section 6).
- **Recommendations:** For all high priority and some medium priority CHAs recommendations are given for further investigation and or management of hazards in the CHA.
- **Notes:** This section contains additional information relating to how the CHA and its extents were derived.

It is important to note that there is potential for coastal hazards to exist on the West Coast outside the specifically defined CHAs described in this report. Many areas of the West Coast have highly active coastal processes occurring but have not been defined as CHAs due to the lack (or small scale) of development (assets) present. Outside of the defined CHAs most potential hazards are associated with:

- **Beaches:** In general, most beaches on the West Coast have some risk of at least short-term erosion and flooding. Moreover, many are affected by a generally northward longshore transport of sediment, thus any change to the sediment supply or wave climate can affect rates and/or patterns of erosion or accretion. Many beaches have low-lying backshore areas where flooding from storm tides can extend well inland.
- **River/creek mouths:** There are many rivers and creeks draining to the West Coast. Longshore transport of sediment at their mouths can result in mouth migration, lagoon formation and mouth closure - causing associated coastal hazards such as flooding and erosion.

CHA1 Karamea

CHA1 extends from Kohaihai Bluff (**BP22 244 489**, 1524460mE, 5448930mN) to Little Wanganui Head (**BQ22 208 174,** 1520890mE 5417460mN). It includes the Break Creek mouth, Oparara River mouth and Estuary, the Karamea River mouth and the Karamea/Otumahana Estuary, and the Little Wanganui River.

CHA1	Karamea
Assets at risk	**Buildings:** Residences around the Karamea/Otumahana Estuary are threatened by erosion and flooding. **Road:** SH67 Karamea Highway is exposed to erosion as it passes around the backshore of the Karamea/Otumahana Estuary. Sections of the Karamea-Kohaihai Road are exposed to erosion where it passes the Oparara Lagoon and Break Creek. **Recreation:** DoC Heaphy track facilities are threatened, as is the Golf Course at Karamea. **Farmland:** Farmland is at threat from erosion and flooding.
Hazard processes	**Erosion:** Migration of the Karamea River mouth, Oparara River mouth and Break Creek mouth can directly erode land during migration as well as change the exposure of the backshore to erosion from swell and storm waves. There is also erosion of the open coast by storm waves. **Flooding:** Wave washover flooding can affect low lying land during storms. The estuary mouths close infrequently but when they do it can result in flooding due to back up of water behind them. **Dune blowouts:** Dune blowouts can deposit large amounts of dune sand on to land immediately behind the existing dune line.
Priority assessment	**Medium:** moderate numbers of assets are at risk. Existing management measures are reasonably effective at reducing hazard.
Existing management	River/lagoon stopbanking exists around Karamea to provide protection from river floods. There are also some short sections of erosion and/or flood protection around other parts of the Karamea lagoon. Part of the Karamea-Kohaihai Road is protected by rock armour adjacent to the Oparara Lagoon. The Karamea River mouth has been mechanically opened in the past to alleviate flooding caused by mouth closure.
Relevant references	Goss, I. W. (2004) *Review of coastal conditions – Resource Consent RC04/14*, prepared for Mr Steve Payne by OCEL Consultants NZ Ltd. Goss, I.W. (2005) *Review of coastal erosion – property at Beach Road, Birchfield*, prepared for Mr Blair Colligan by OCEL Consultants NZ Ltd. Goss, I.W. (2005) *Review of coastal erosion – property at Manns Road, Birchfield*, prepared for Mr Mark Rapley by OCEL Consultants NZ Ltd. Goss, I. W. (2008) *Review of coastal erosion hazard – Property at Oparara Estuary*, prepared for Kowhai Farms Ltd by OCEL Consultants NZ Ltd. Rose, R. (2006) *Hazard Report Kongahu Beach Karamea*, CRL Energy Ltd, Report Ref: 06-41141

CHA1	Karamea
Notes	This CHA was reviewed in 2012 and is based on CHA 1 from the 2000 Regional Coastal Plan (WCRC 2000). The northern limit was extended from Oparara up to Kohaihai Bluff to include the road and DoC Heaphy Track facilities.

CHA2 Mokihinui

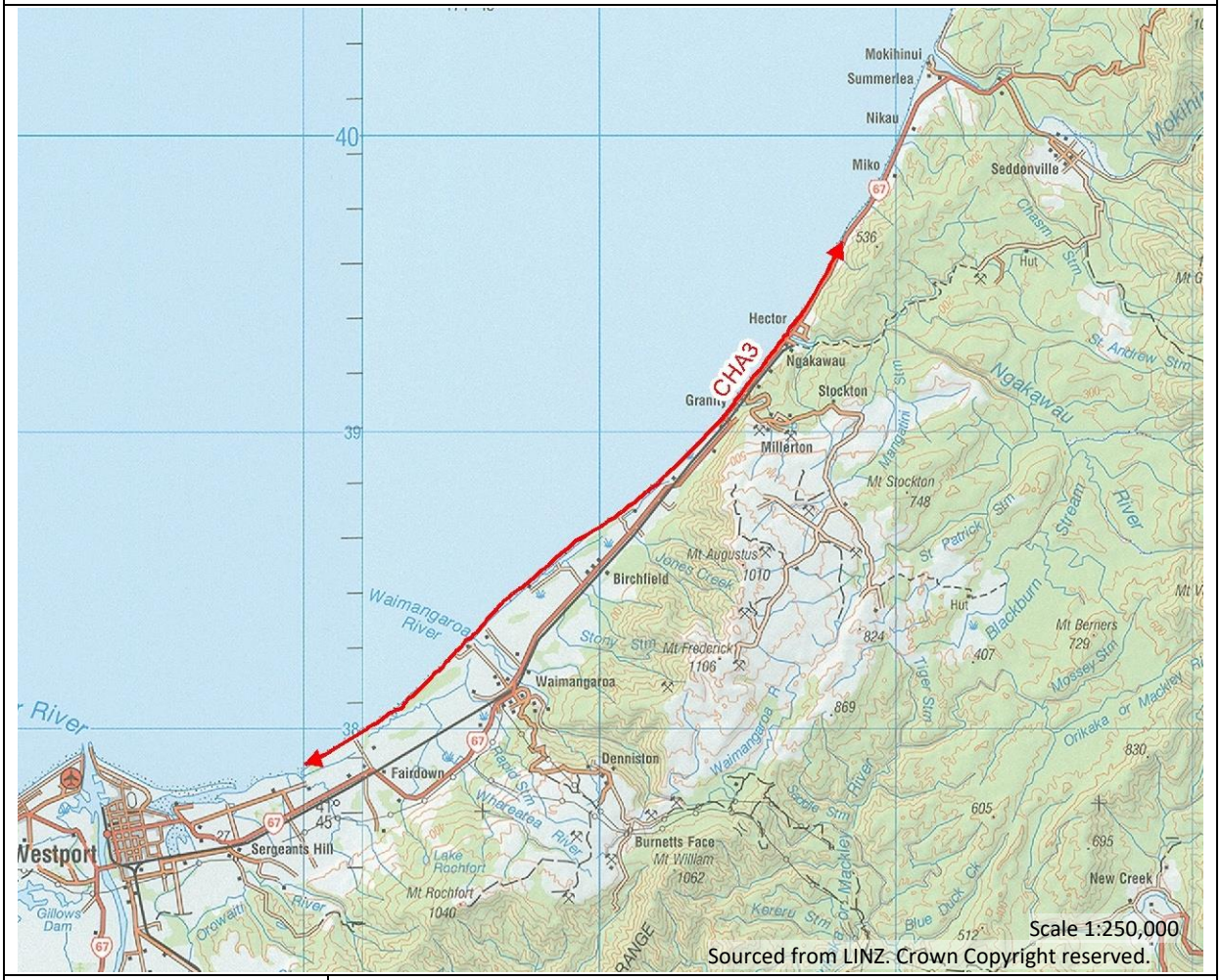
CHA2 extends from Gentle Annie Point (**BR21 120 046,** 1512040mE 5404600mN) to the south of Miko (**BR21 094 985**, 1509460mE 5398530mN)

Assets at risk	**Buildings:** Residences at Mokihinui and Gentle Annie are threatened by erosion and flooding. **Road:** Part of Gentle Annie access road threatened by erosion. **Farmland:** Farmland is being lost to erosion.
Hazard processes	**Erosion:** Long term erosion affects the coastline along this CHA. Erosion rates are higher nearer the Mokihinui River mouth. Mouth migration also threatens to cause erosion to the north bank of the Mokihinui River mouth. **Flooding:** Wave washover flooding affects land behind the beach.

CHA2	Mokihinui
Priority assessment	**Medium:** On-going erosion and sea-flooding threatens existing buildings.
Existing management	Groynes and riprap have been installed on the north bank of the Mokihinui river mouth (Gentle Annie side) to prevent northward migration of the mouth causing further erosion. A bund has been constructed between Mokihinui township and the foreshore, to prevent wave washover flooding of properties.
Relevant references	Goring, D.G. (2011) *Statement of evidence for Meridian Energy Ltd*, Environment Court Christchurch ENV-2010-CHC-115, 123, 124 and 135 Goss, I. W. (2004) *Review of coastal erosion hazard – property at De Malmanches Road, Mokihinui*, prepared for Messrs C M Scanlon & D Atkins, Mr P H and Mrs E P Atkins by OCEL Consultants NZ Ltd. Hicks, M., Rouse, H., Tunnicliffe, J. and Walsh, J. (2007) *Mokihinui River Proposed Hydropower Scheme: Sediment Report*, NIWA Client Report CHC2007-117. Hicks, M., Dickson, M. & Gorman, R. (2007) *Mokihinui River Proposed Hydropower Scheme: Shoreline change around the Mokihinui River mouth*, NIWA Client Report CHC2007-136. Reinen-Hamill, R.A. (2011) *Statement of evidence for Meridian Energy Ltd*, Environment Court Christchurch ENV-2010-CHC-115, 123, 124 and 135Tonkin & Taylor Ltd (2009) *Mokihinui River Proposed Hydropower Scheme Coastal Management Options Evaluation*, T&T Ref: 25300.001
Notes	This CHA was reviewed in 2012 and is based on the CHA 2 from the 2000 Regional Coastal Plan (WCRC 2000).

CHA3 Hector, Ngakawau and Granity

CHA3 extends from 400m north of Lamplough Stream (**BR21 081 964**, 1508180mE 5396440mN) to the mouth of the Orowaiti Lagoon (**BR20 900 788**, 1490040mE 5378800mN). The CHA includes Hector, Ngakawau and Granity as well as the Ngakawau and Waimangaroa Rivers and several smaller creeks.



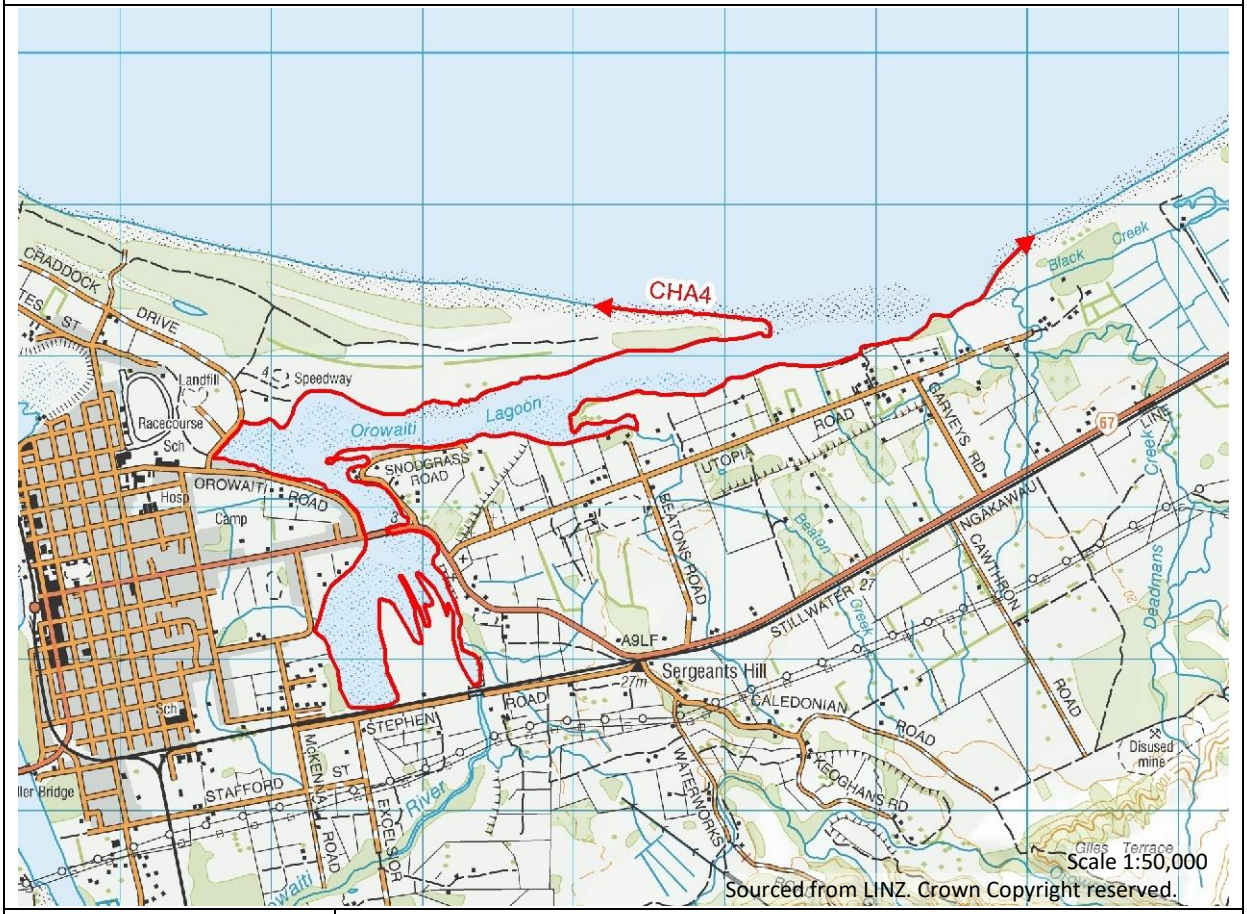
Assets at risk	**Buildings:** Residential properties and school in Granity, Hector and Ngakawau are affected by erosion and flooding. In general, property to the west of SH67 in Hector, Ngakawau and Granity is very vulnerable to erosion and flooding. New subdivisions at the south end of the CHA have been set back to allow for continuing erosion. **Road:** Sections of SH67 (Karamea Highway) are likely to be threatened by erosion and flooding in the future. **Farmland:** Particularly in the southern half of this CHA significant areas of farmland are being lost to erosion.

CHA3	Hector, Ngakawau and Granity
Hazard processes	**Erosion:** The shoreline in CHA3 is experiencing long term erosion combined with short-medium term (1-20 year time frame) cycles of accretion and erosion. Erosion is caused by wave driven abrasion and transport of material northward exceeding sediment supply from rivers and from the coast to the southwest. Erosion rates vary over the length of the CHA as well as over time due to varying wave conditions and sediment inputs from rivers. Temporal variability is greatest near the mouths of the Ngakawau and Waimangaroa Rivers. Erosion rates in this CHA are sensitive to changes in sediment supply from the southwest (for example: sea-level rise resulting in build-up of beaches and storage of sediment west of the Buller River training walls). Any management practices which affect sediment delivery or movement along the shore within this CHA (i.e., groynes, beach mining or seawalls) have potential to impact on erosion rates/patterns. **Flooding:** The low lying coastal land in this CHA is subject to wave washover flooding during storms. This risk is increased by erosion of the gravel barrier at the back of the beach. Extensive property and road flooding occurred during ex-tropical cyclone Fehi. Flood risk will increase with sea-level rise.
Priority assessment	**High:** Many buildings are at risk from coastal erosion in the near future (notably the Granity School). Coastal hazards are having a severe impact on the communities along this CHA.
Existing management	At various properties in Hector, Ngakawau and Granity, sea walls or bunds have been constructed. These are highly variable in design and condition. Whilst effective in the short term, these structures will not provide long term protection. Vegetated buffer zones have been planted along some parts of the coast to help slow erosion. At some river/creek mouths rip-rap armouring has been used to prevent mouth migration. Detailed analysis to map the inland extent of areas exposed to inundation and erosion hazard is currently underway for the Te Tai o Poutini Plan (December 2021). This analysis will provide much greater detail than this report and will enable improved planning and management of risks.

CHA3	Hector, Ngakawau and Granity
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Allis, M. (2016a). *Adapting to coastal change at Granity, Ngakawau and Hector*. *NIWA Client Report HAM2016-012, prepared for West Coast Regional Council*. Allis, M.J. (2016b). Letter note to WCRC (Paulette Birchfield) on advice in *Adapting to coastal change at Granity, Ngakawau and Hector* (NIWA, 2016) for community meeting 22-Nov 2016. 4p. Benn, J. (2002) *Evaluation of the effects of Stone Removal North of Westport*, prepared for West Coast Regional Council by DTec Consulting Ltd. Benn, J. and Todd, D. (2005) *Coastal Hazards Assessment: Proposed Fairydown Farm Sub-division; Beach Road, Whareatea River, Buller District*, report for Fairydown Farm Ltd by DTec Consulting Ltd. Benn, J. and Todd, D. (2007) *Review of Proposed Coastal Protection Works for 12a-14 Main Road, Ngakawau*, report for Alan Merrett by DTec Consulting Ltd. Benn, J. and Todd, D. (2010) *Updated Coastal Erosion Assessment: Fairydown Farm Sub-division; Beach Road, Whareatea River, Buller District*, report for Fairydown Farm Ltd by DTec Consulting Ltd. Ramsay, D. (2006) *Managing and Adapting to Coastal Erosion on the West Coast: Granity*. Prepared for West Coast Regional Council, NIWA Client Report HAM2006-153. Ramsay, D. (2007) *Managing and Adapting to Coastal Erosion on the West Coast: Ngakawau and Hector*. Prepared for West Coast Regional Council, NIWA Client Report HAM2007-007. Single, M. (1999) *Statement of evidence regarding physical coastal processes at the site of the proposed West Coast Coal Terminal*. Single, M. (2009) *Review on the effects on the physical coastal processes of a proposed groyne at Ngakawau*, report for Allan Tyler by Shore Processes and Management Ltd.
Notes	This CHA is based on CHA 3 from the 2000 Regional Coastal Plan (WCRC 2000). It has been slightly extended to the north to include areas of proposed/potential subdivision to the north of Hector.

CHA4 Orowaiti Lagoon

This CHA covers the Orowaiti Lagoon and the coastline affected by the Orowaiti River mouth processes (from **BR20 900 788**, 1490040mE 5378800mN to **BR20 871 783**, 1487130mE 5378330mN). The northern limit of this CHA is the same as the southern limit of CHA3.



Assets at risk	**Buildings:** Many existing houses around the lagoon shore are at risk from flooding and erosion. This includes properties along Snodgrass Road, Orowaiti Road and in low lying areas of northern Westport. **Road:** The SH67 bridge approaches have been flooded from the lagoon and have also been affected by erosion requiring protection measures. Other minor roads are also threatened. Various 'paper' roads north of Utopia road have already been lost to erosion. **Farmland:** Land north of Utopia Road has been lost to erosion. Some of this land is subdivided.

CHA4	Orowaiti Lagoon
Hazard processes	**Flooding:** There are extensive low lying areas around the lagoon where properties, roads and farmland are threatened by high tides, storm surges and river floods. Sea-level rise will significantly increase this risk in the future. **Erosion:** Erosion due to mouth migration (generally eastwards) has caused significant land loss in the past and is on-going. Mouth migration can change the exposure of the shore to wave action and can also cause erosion by river flows. Within the lagoon, local wind-waves and river floods can cause bank erosion.
Priority assessment	**High:** Houses and roads in low lying areas around Orowaiti Lagoon are at significant risk of flooding from the sea (and/or Buller River flood overflows into the Orowaiti). Within the lagoon the erosion hazard is not too severe and can be managed with the use of bank protection. At the lagoon mouth the hazard processes are much more severe and difficult to manage but there are fewer assets at risk.
Existing management	Around the lagoon various short sections of shoreline are armoured to prevent erosion. At the lagoon mouth several large groynes have been constructed on the South side of the mouth to try and prevent erosion/mouth migration. Several of these have already been outflanked. Some properties have raised floor levels to mitigate flood risk. Bunds alongside Snodgrass Road provide some protection from flooding, and culverts under the road have flapgates to allow drainage whilst preventing inflow from the sea. Flood hazard mapping is available from hydrodynamic modelling of river and coastal flood risk. Work is underway to develop a flood forecasting system for river and coastal inundation of Westport, including the Orowaiti Lagoon. This system is planned to be operational in 2022. Detailed analysis to map the inland extent of areas exposed to inundation and erosion hazard is currently underway (December 2021). This analysis will provide much greater detail than this report and will enable improved planning and management of risks.

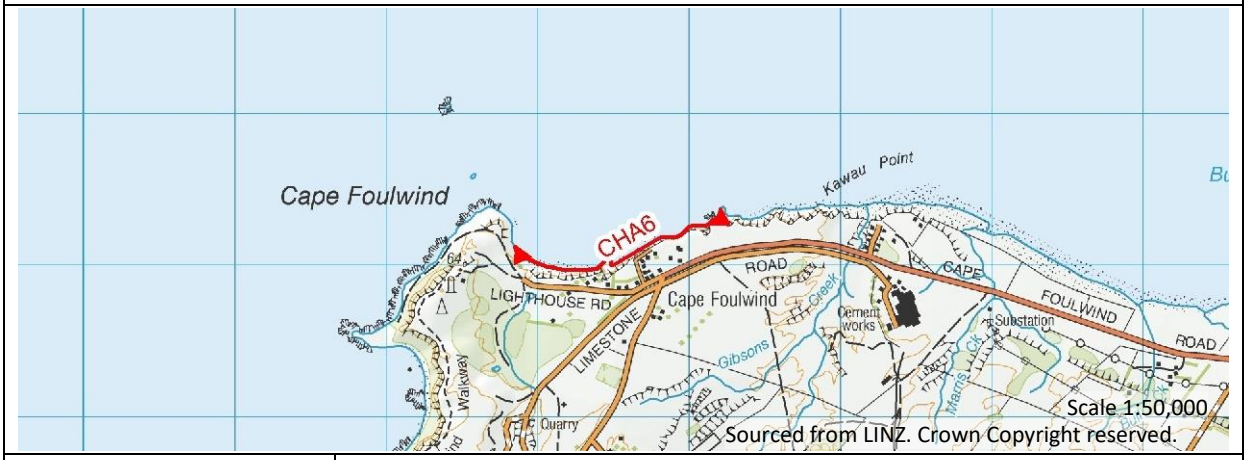
CHA4	Orowaiti Lagoon
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Allis M. (2015) NIWA letter to Michael Meehan WCRC dated 6 May 2015 providing advice regarding proposed floodway cut options between the Orowaiti Lagoon and Tasman Sea. Allis, M.J, et al. (2017). *Managing and adapting to coastal erosion on the West Coast: Carters Beach*. NIWA Client Report 2017119HN, West Coast Regional Council: 36. Dennis, F.E. (1996) *Stability of Utopia Road Property*, prepared for Mr G R Millar by OCEL Consultants NZ Ltd. Gardner M. (2017) Buller River: Update of hydraulic model, *Land River Sea Consulting Ltd Report for West Coast Regional Council*. Goss, I.W. (2011) *Review of coastal hazard as it affects building siting at lot DP 12836, Utopia Road, Westport*, prepared for Mr and Mrs B. J. and L. A. A. Donaldson by OCEL Consultants NZ Ltd.
Recommendations	**Development of hazard zones for this CHA is recommended**. The existing flood mapping model should be used to simulate scenarios of severe storm surge in the absence of river flooding (the model currently focuses on risk from river flooding, so may possibly under-estimate hazard to property around the Orowaiti Lagoon). Flood hazard data should be included in property Land Information Memorandum (LIM) reports (whilst the existing flood mapping studies are publicly available this information has not been included in LIMs). Minimum floor levels for new developments should be specified based on flood mapping data.
Notes	This CHA was created as part of the 2012 review of coastal hazard areas. CHAs 3 and 4 are separated because they are each affected by different hazard processes. Following the extensive property flooding during ex-tropical cyclone Fehi the priority was increased to High. Extensive flooding of this area also occurred during the 2021 Buller River flood.

CHA5 Carters Beach

This CHA extends from the Buller River mouth (**BR20 824 795**, 1482470mE 5379510mN) to a point level with Bradshaws Road, west of Carters Beach (**BR20 789 769**, 1478930mE 5376950mN).

Assets at risk	**Recreation facilities:** The sports fields of the domain are being affected by erosion and wave overtopping. The unsealed access road between the sports fields and beach (Rotary Road) has been truncated and closed due to erosion. **Buildings:** Low lying properties behind the domain/sports fields are at risk of flooding during high tides/storm surges. New subdivisions at the west end of the CHA have been set back to manage the erosion risk. **Airport:** Westport Airport runway extends close to the beach which is currently experiencing erosion. If erosion continues the runway may be threatened. **Farmland:** Farmland to the east and west of Carters Beach is threatened by erosion and flooding
Hazard processes	**Erosion:** The coastline at Carters Beach consists of low-lying sands deposited following the construction of the Buller River training walls (as a result of the dominant west-east longshore transport). There is no vegetation nor significant foredune protecting the backshore, and the coastline position is very sensitive to any change in wave climate or sediment supply. The coastline reached a position of maximum advance around 1981 and since then has eroded by approximately 40 m. It is not known whether this is short-medium term variability as the shoreline settles into a new equilibrium or the start of a longer term trend relating

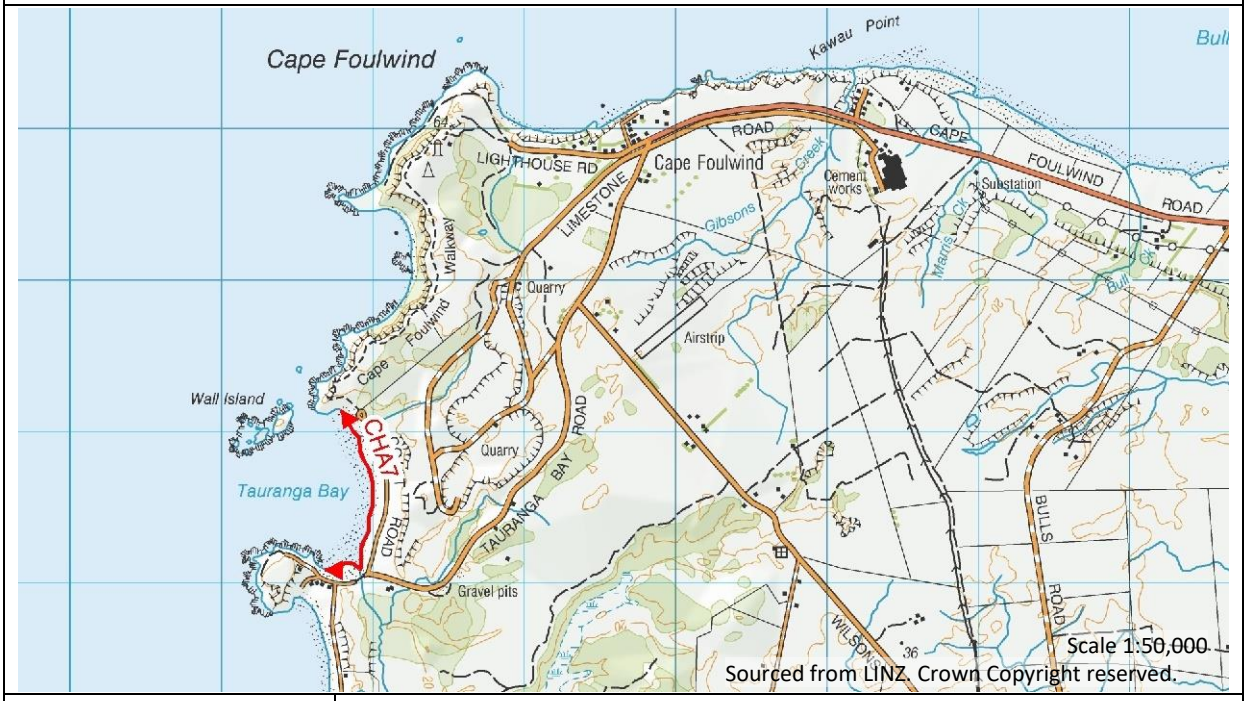
CHA5	Carters Beach
	to either/both a change in wave climate and/or a reduction in the supply of littoral drift sand from the south. **Flooding:** Land along this section of coast is very low lying and is affected by wave overtopping and flooding. **Down-drift effects:** The dominant west-east longshore transport drives sediment from this CHA past the Buller River training walls towards CHA3. Actions in this CHA (e.g., groynes, sand mining) have the potential to influence erosion rates to the east of the Buller River.
Priority assessment	**Medium:** Erosion and flooding are currently affecting recreation facilities at Carters Beach. If erosion continues at current rates the risk to buildings and the airport will increase.
Existing management	There are no existing defences. A monitoring program was implemented by Buller District Council in 2006. New subdivisions to the west of Carters Beach have been set back from the coast to allow for erosion hazards.
Relevant references	Allis, M.J, et al. (2017). Managing and adapting to coastal erosion on the West Coast: Carters Beach. *NIWA Client Report 2017119HN prepared for West Coast Regional Council*. 36p. Allis, M.J., Hicks, D.M. (2019) Adapting to coastal change at Carters Beach, New Zealand. In: P. Wang, J.D. Rosati & M. Vallee (Eds). *Coastal Sediments 2019: Proceedings of the 9th International Conference*. World Scientific Publishing, Singapore: 1550-1561. https://doi.org/10.1142/9789811204487_0134 Furkert, F.W. (1946) *Westport Harbour*, Transactions of the Royal Society of New Zealand, Vol. 76, Part 3, pp373-402. Kirk, R.M., Hastie, W.J., and Lumsden, J.L. (1986) *Sedimentary Processes Operating Around a River Mouth Port, Westport, New Zealand*. New Zealand Journal of Marine and Freshwater Research, Vol. 20, pp 337-347. Kirk, R.M., Hastie, W.J., & Lumsden, J.L. (1987) *Harbour Entrance Morphology and Sediments at a River Mouth Port, Westport, New Zealand*. New Zealand Journal of Marine and Freshwater Research, Vol. 21, pp 689-691. OCEL Consultants NZ Ltd (2006) *Review of Coastal Erosion - Carters Beach*, for Buller District Council.
Recommendations	**Continued monitoring of erosion rates is recommended**. Monitoring will help inform understanding of the processes affecting Carters Beach.
Notes	This CHA was created as part of the 2012 review of coastal hazard areas. Erosion is a relatively recent occurrence here as previously the shoreline has advanced in this area. Recent studies and site inspection confirm active erosion on this stretch of coast at least in the short-term.

CHA6 Omau	
The Omau CHA stretches along the cliff front adjacent to Omau from **BR20 742 773** (1474200mE 5377380mN) to **BR20 728 771** (1472840mE 5377130mN).	
	
Assets at risk	**Buildings:** Several existing buildings (houses and baches), as well as the access to them is threatened. Several currently subdivided plots of land are threatened. The gardens of several existing buildings are currently being eroded, as are parts of Clifftop Lane.
Hazard processes	**Erosion:** The cliffs at Omau are relatively weak compared to those at Cape Foulwind and are they are retreating as the narrow beach at their base is eroded. Erosion rates are more severe at the eastern end of the CHA. As well as retreat of the cliffs by progressive toe-cutting and slab-failure, consideration needs to be given to the risk of broader, lower-angle collapse/landslide.
Priority assessment	**Medium:** Cliff retreat means that several residences and subdivided plots of land in Omau are likely to be affected by erosion within 50-100 years.
Existing management	New houses/baches are being set back to manage the future threat of erosion. The lifespan being applied to calculate setbacks varies. The extent of some plots limits the setback which can be applied to any construction within them.

CHA6	Omau
Relevant references	Yetton, M. (2004) *Geotechnical report in relation to a proposed building site at Lighthouse Road, Cape Foulwind, West Coast*, prepared for Mr Wayne Barcas by Geotech Consulting Ltd. Report Ref. 1500. Yetton, M. (2005) *Geotechnical report in relation to proposed subdivision of Section 48, Omau, Cape Foulwind, West Coast*, prepared for Shane Saunders by Geotech Consulting Ltd. Report Ref. 1568. Yetton, M. (2009) *Geotechnical report in relation to proposed house construction at Section 28, Omau, Cape Foulwind, West Coast*, prepared for David Johns by Geotech Consulting Ltd. Report Ref. 1795. Yetton, M. (2010) *Geotechnical report in relation to proposed house construction at Lot 2 DP 385916, Omau, Cape Foulwind, West Coast*, prepared for Mark McIntyre by Geotech Consulting Ltd. Report Ref. 1833.
Recommendations	**Monitoring of cliff retreat is recommended**, particularly following any significant collapse. At some point in the future existing buildings may need to be evacuated/removed/relocated to prevent risk to life as a result of cliff collapse/erosion.
Notes	This CHA was established as part of the 2012 review of coastal hazard areas.

CHA7 Tauranga Bay

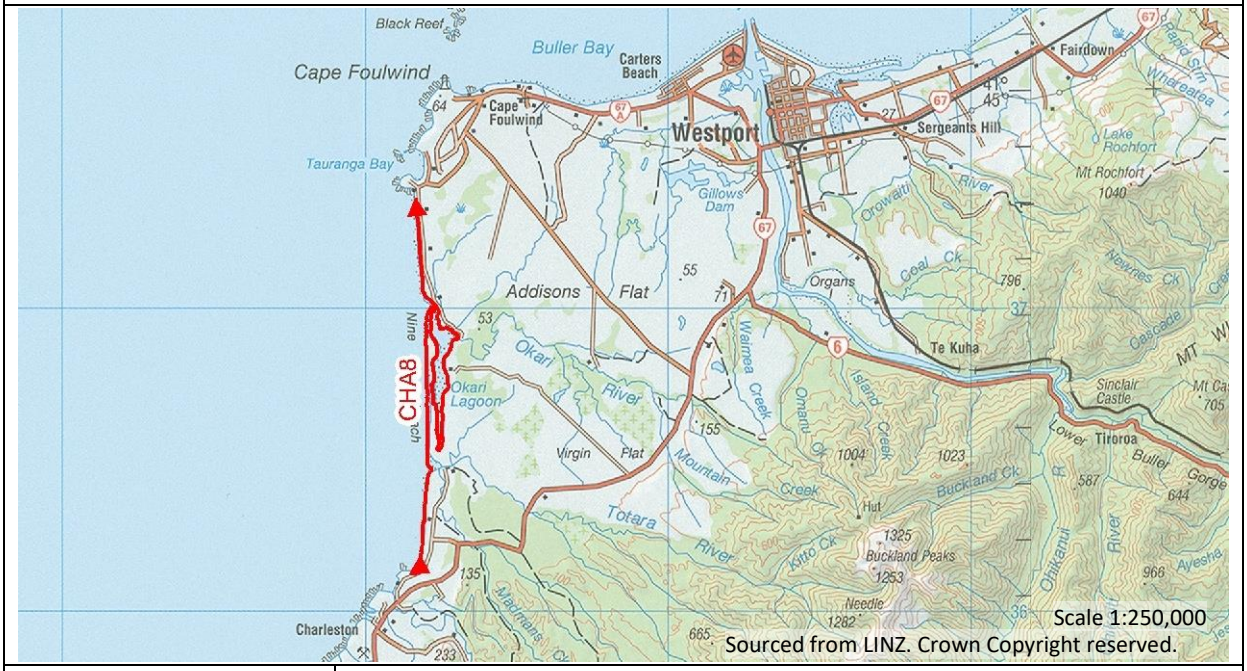
This CHA covers the shoreline around Tauranga Bay from the DoC Cape Foulwind Walkway car park in the North (**BR20 717 751**, 1471780mE 5375150mN) to the houses at the southern end of the bay (**BR20 716 740**, 1471680mE 5374090mN).



Assets at risk	**Recreation facilities:** Road access and parking for the Cape Foulwind Walkway (DoC).
Hazard processes	**Erosion:** Creek mouth migration threatens parts of the access road and has caused problems in the past requiring erosion protection. Wave driven erosion is affecting parts of the bay and has threatened the parking area. **Flooding:** Wave washover flooding affects some areas around the bay
Priority assessment	**Low:** Hazard processes are not particularly severe and erosion protection measures appear to be reasonably effective at present. The value of assets at risk is relatively low and in the long term it would be possible to relocate access to Cape Foulwind Walkway if required.
Existing management	Rock armour has been used to protect parts of the road and the DoC car park.
Relevant references	Liefting, R. and Cochrane, P. (2011) *Tauranga Bay Subdivision Coastal Hazards – Further Information*, Tonkin & Taylor, T&T Ref. 870932
Notes	This CHA is based on CHA 4 from the 2000 Regional Coastal Plan (WCRC 2000).

CHA8 Nine Mile Beach

The Nine Mile Beach CHA stretches from near the north end of the beach (**BR20 716 736**, 1471680mE 5373610mN) to Parsons Hill at the south end of the beach (**BS20 715 612**, 1471550mE 5361270mN). The CHA includes the Okari Lagoon and the mouth of the Totara River.

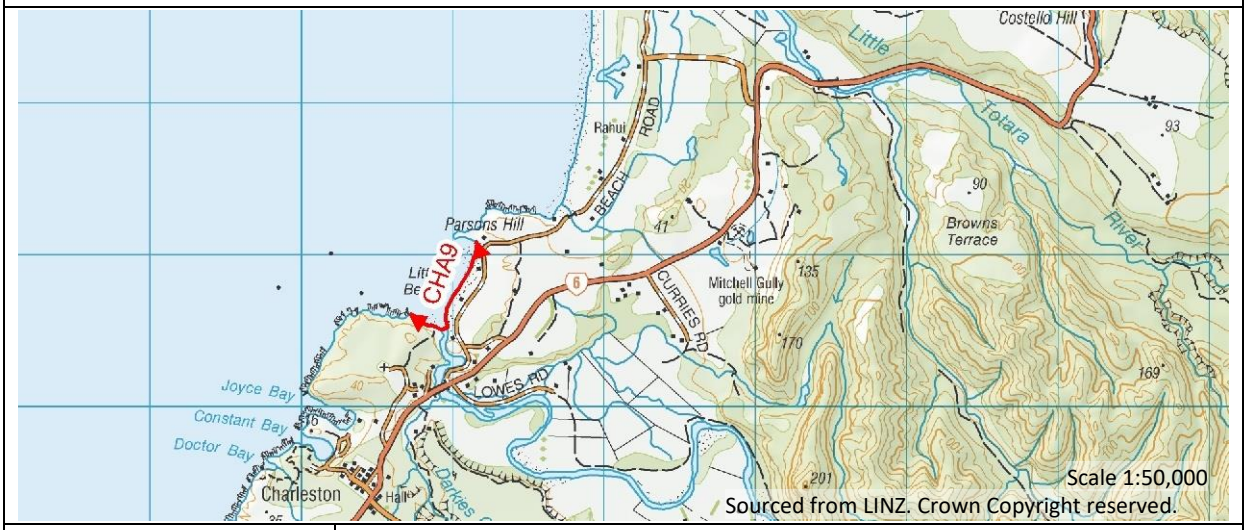


Assets at risk	**Buildings:** Generally, buildings along this stretch of coast are adequately set back to manage their exposure to coastal hazards. With further development and continuing erosion there may be increasing hazards to buildings in the future. **Road:** Parts of Okari Road are threatened by erosion, particularly near the mouth of the Okari Lagoon. **Farmland:** Farmland behind Nine Mile Beach is being lost to erosion. Some of this farmland has been subdivided for residential development but generally the subdivision sites are adequately set back to manage the erosion risk.
Hazard processes	**Erosion:** Northward longshore transport is resulting in long term erosion of Nine Mile Beach. Erosion rates are fastest at the southern end of the beach, although during Fehi and Gita significant erosion occurred at the northern end of the beach. Mouth migration can cause local erosion at much faster rates around the Okari Lagoon mouth and Totara River mouth. Changes or management actions affecting sediment supply to the beach or sediment movement along the beach have the potential to change erosion rates/patterns. **Dune Blowouts:** The beach is backed by dunes, and dune blowouts can occur as a result of wave/wind action during storms.

CHA8	Nine Mile Beach
Priority assessment	**Low:** Existing buildings are generally set back far enough so that erosion is unlikely to affect them in the near future. The risk to new development is being adequately managed by setting back buildings appropriately.
Existing management	New subdivisions and buildings are being set back to manage erosion risk. Some rock erosion protection exists around the lagoon mouth including a small groyne to prevent causeway outflanking and to help resist lagoon mouth migration.
Relevant references	Goss, I.W. (2005) *Review of coastal erosion hazard – property at Okari Road, Tauranga Bay*, prepared for Mr & Mrs D A and L A Graham by OCEL Consultants NZ Ltd. Goss, I.W. (2006) *Review of coastal erosion – property at Okari Road, Tauranga Bay*, prepared for Ms Janet Pottinger by OCEL Consultants NZ Ltd. Goss, I.W. (2007) *Review of coastal erosion – property at Okari Road, Tauranga Bay*, prepared for Ms Jude Green by OCEL Consultants NZ Ltd. Goss, I. W. (2009) *Review of coastal erosion – Lot 1 of proposed subdivision at Okari Road, Tauranga Bay*, prepared for Mr J M Rogers by OCEL Consultants NZ Ltd. Goss, I. W. (2011) *Review of coastal erosion – Nine mile beach, Charleston*, prepared for Mr G N Stott by OCEL Consultants NZ Ltd. Rose, R.V. (2006) *Causes and remedies for coastal erosion and the contribution made by hobby scale gold mining – South Nine Mile Beach near Charleston*, Prepared for Geoff Hill by Resource Management Services. Yetton, M. (2004) *Geotechnical report in relation to proposed building site at Beach Road, Charleston, West Coast*, prepared for Lyn Inglis by Geotech Consulting Ltd. Report Ref. 1501.
Notes	This CHA is based on CHA 5 from the 2000 Regional Coastal Plan (WCRC 2000). Little Beach has been moved into a separate CHA as it is in a separate embayment and the processes are only weakly linked.

CHA9 Little Beach

CHA 9 covers the whole of Little Beach, from **BS20 711 610** (1471150mE 5361090mN) to **BS20 707 606** (1470710mE 5360600mN).



Assets at risk	**Buildings:** Several baches are at high risk of erosion and flooding, with little buffer space left between the beach and the buildings. **Road:** Beach road is threatened by erosion.
Hazard processes	**Erosion:** Long term beach erosion affects the whole of Little Beach. **Flooding:** Wave washover flooding affects low lying land behind the beach.
Priority assessment	**Medium:** There are only limited assets in the CHA but several of the baches are threatened by erosion in the near future.
Existing management	Some erosion protection has been installed to protect existing baches.
Notes	In the 2000 Regional Coastal Plan (WCRC 2000) Little Beach was combined with Nine Mile Beach in CHA 5. As part of the 2012 coastal hazard assessment Little Beach was moved into a separate CHA as it is in a separate embayment and the processes are only weakly linked.

CHA10 Woodpecker Bay

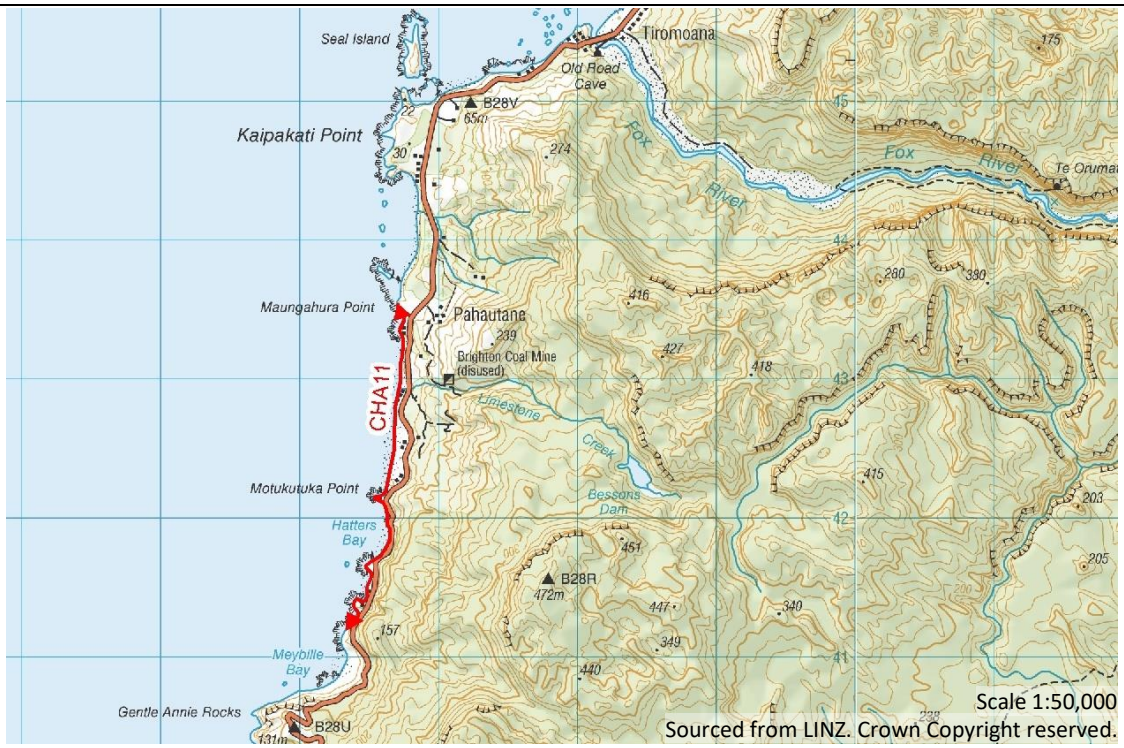
The Woodpecker Bay CHA extends from **BS19 672 484** (1467220mE 5348440mN) to **BS19 649 449** (1464910mE 5344980mN). This CHA includes Tiromoana and the mouth of the Fox River.

Assets at risk	**Road:** SH6 is threatened by erosion and flooding at several locations. **Buildings:** Baches are threatened by erosion and flooding.
Hazard processes	**Erosion:** Woodpecker Bay is a pocket beach with limited sediment supplies (main source Fox River). The erosion focus is towards the centre and northern parts of the bay because these areas have greater exposure to south westerly and westerly swells, and experience greater northerly drift. Northerly swells during Fehi caused extensive damage at the southern part of the bay. **Flooding:** Wave washover flooding affects the land immediately behind the beach. Extensive flooding and wave washover damage occurred during cyclone Fehi.
Priority assessment	**Medium:** SH6 is severely threatened by erosion for an extended distance within this CHA but there are few other assets at risk.

CHA10	Woodpecker Bay
Existing management	Rock protection/seawalls have been installed to protect some existing baches and parts of SH6.
Relevant references	Benn, J. (2004) *Assessment of Environmental Effects of Proposed Gravel Extraction from the Fox (Potikohua) River: Resource Consent Application RC03329*, prepared for Fitzcarraldo Investments Ltd (Wellington) by DTec Consulting Ltd Ward, H. (2010) *Assessment of Environmental Effects – Woodpecker Bay Rock Protection*, prepared for NZTA by Opus International Consultants Ltd
Notes	There is little change to this CHA from CHA 6 in the 2000 Regional Coastal Plan (WCRC 2000) except to extend its southern end to Seal Island to include additional locations where SH6 is at risk.

CHA11 Maungahura Point to Meybille Bay

CHA11 encompasses an exposed section of coast consisting of narrow beaches between small rocky outcrops. This CHA extends from Maungahura Point (**BS19 647 435**, 1464700mE 5343550mN) to the rocky outcrop at the north end of Meybille Bay (**BS19 643 412**, 1464330mE 5341200mN)



Assets at risk	**Road:** SH6 is very close to the shoreline along the length of this CHA and is threatened in several places. **Buildings:** Several baches between the SH and coast are exposed to erosion and wave washover flooding.
Hazard processes	**Erosion:** Long term erosion is occurring along this coast but at a relatively slow rate. Vulnerability to erosion is very variable along this CHA depending on local conditions (geology, sediment supply and sheltering from waves by headlands or offshore rocks). **Flooding:** Wave washover at high tides can affect lower lying parts of the road and baches, although generally the shoreline slopes quite steeply behind the beach along this CHA.
Priority assessment	**Low:** Hazard processes are not severe and are being managed reasonably effectively through the use of short sections of protection where required.
Existing management	Rock armour and concrete sea walls have been used to protect short sections of SH6 where it has been threatened by erosion.
Notes	This CHA was created as part of the 2012 review of coastal hazard areas.

CHA12 Punakaiki Village (Pororari Beach)

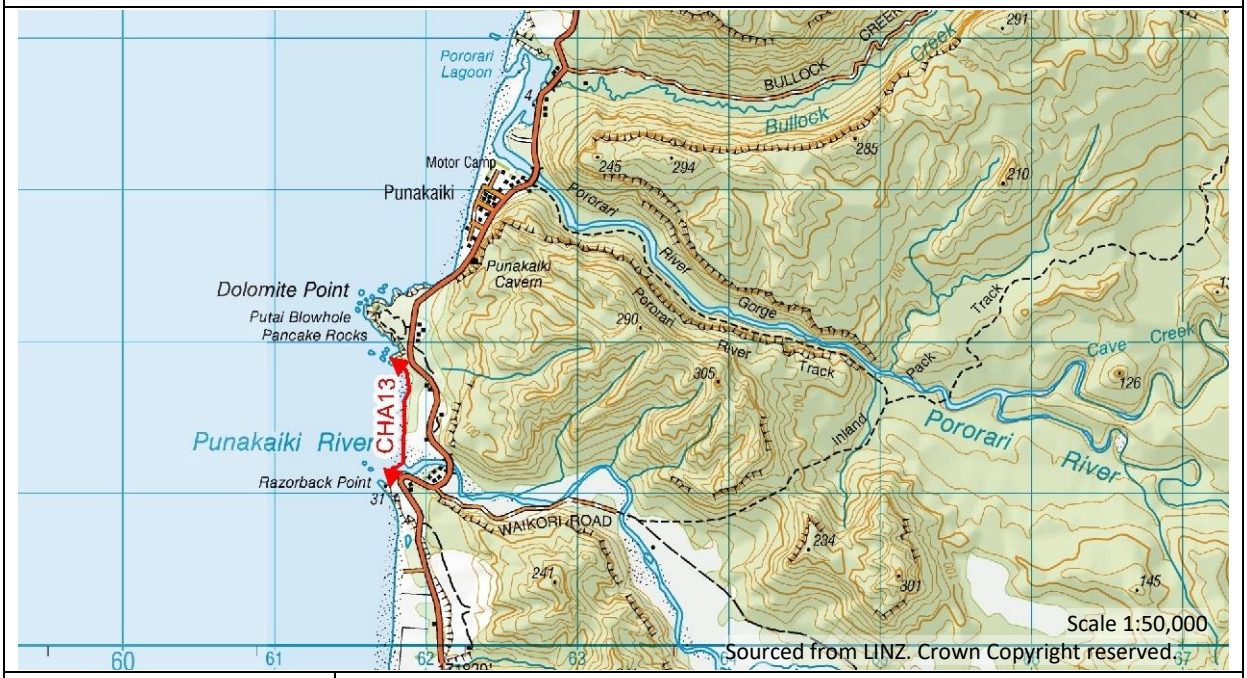
This CHA covers the length of beach in front of Punakaiki Village including the Pororari River mouth and lagoon. The CHA stretches from **BS19 626 382** (1462630mE 5338260mN) to **BS19 619 363**(1461940mE 5336380mN).

Assets at risk	**Buildings:** Much of Punakaiki Village is threatened, including houses and tourist accommodation (hotels, hostels and motor camp). **Road:** SH6 is threatened by erosion at the Southern end of the CHA. **Recreation:** The width of the beach and access to the beach are being affected as erosion of the beach occurs in front of the seawall.
Hazard processes	**Erosion:** Long term erosion of the beach is occurring in front of the village as a result of wave attack and northward longshore transport. There is also an erosion risk associated with river mouth migration. **Flooding:** Storm waves overtopping the beach can cause flooding.
Priority assessment	**High:** Erosion is continuing and is very close to the buildings in the village. The recreational value of the beach is being reduced through continuing erosion in front of the seawall.

CHA12	Punakaiki Village (Pororari Beach)
Existing management	A rock-armoured seawall has been constructed continuously from SH6 at the southern edge of the bay across in front of the village. The seawall consists of a raised bund with sloping rock armour extending down its seaward face to beach level. The seawall has been extended over time to protect the campground as well as the village. Detailed analysis to map the inland extent of areas exposed to inundation and erosion hazard is currently underway (December 2021). This analysis will provide much greater detail than this report and will enable improved planning and management of risks.
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Allis, M. (2020) *Coastal changes and future coastal management at Punakaiki*. NIWA Client Report 2020236HN: 37. Coll, C.J. (2014) *Punakaiki Township, coastal erosion cross-sections February 2014*. Plots and data prepared for West Coast Regional Council. C.J. Coll Surveying Ltd, Westport, 5 March 2014. Hamilton, J. McF. (1983) *Punakaiki sea erosion*. Westland Catchment Board and Regional Water Board Letter, Ref 921000, October 1983. Hicks (2015) *Stability of seawall at Punakaiki*. NIWA, Technical note for West Coast Regional Council. 8 September 2014 Kirk R. M. (1988) *Coastal Erosion and Inundation at Punakaiki Village (Pororari Beach) Westland 1983-1986*. Report to Department of Conservation, Buller District, Westport, March 1988. Neale, D. 1997. *Evidence of Don Neale in the matter of the Coastal Permit Application RC96/20 by Buller District Council*. Neale, D. 2007. *Evidence of Don Neale in the matter of Resource Consent Application RC06134 by Buller District Council, for a coastal erosion protection structure at Punakaiki*. Ramsay D., (2007) *Punakaiki seawall impacts.* NIWA, Technical note for West Coast Regional Council.
Recommendations	**Monitoring is recommended for this CHA.** Post event monitoring of the condition of the seawall, the beach toe in front of it, and the unprotected shore at the ends is recommended as the sea wall is having a large effect on coastal processes.
Notes	This CHA is based on CHA 7 from the 2000 Regional Coastal Plan (WCRC 2000). There is little change to the CHA extents or processes but the risk to the village and the road has increased due to continuing erosion. This has resulted in the installation, and subsequent extension, of the seawall.

CHA13 Punakaiki River Beach

CHA 13 covers the coast from south of Pancake Rocks (**BS19 617 359**, 1461760mE 5335900mN) as far as Razorback Point (**BS19 617 350**, 1461750mE 5335050mN). The CHA includes the mouth of the Punakaiki River.

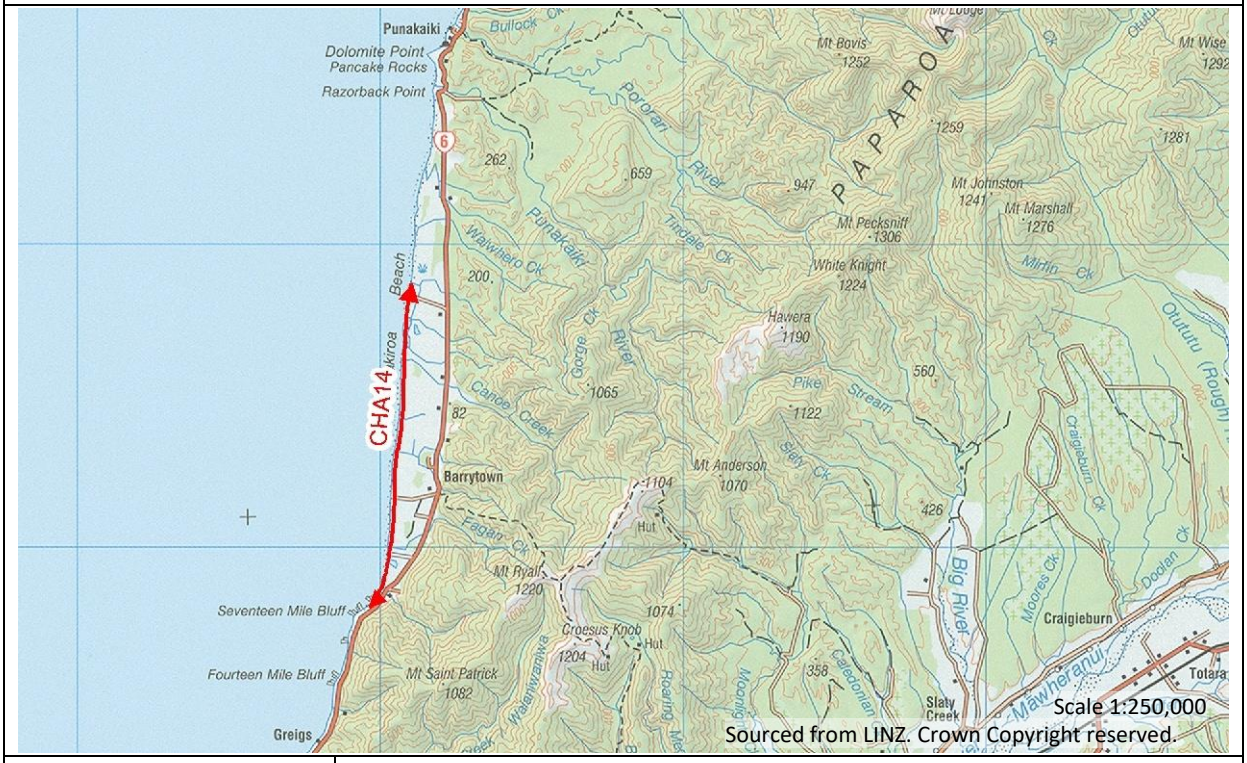


Assets at risk	**Buildings:** Hotel and baches. **Road:** A short length of SH6 is at risk.
Hazard processes	**Erosion:** River mouth migration threatens to erode land at the southern end of the bay. There is little long-term erosion, but short-term shoreline changes do affect the CHA and it is sensitive to any changes in external controls (i.e. sea-level rise or change in sediment supply) which may cause erosion. **Flooding:** Wave washover flooding affects land behind the beach.
Priority assessment	**Medium:** There is little long-term erosion, but assets located behind the beach have very little buffer space and are very vulnerable to any future changes affecting coastal processes.
Existing management	Groynes and rock protection have been installed on the south bank of the mouth of the Punakaiki River to manage the risk of erosion cause by mouth migration. Detailed analysis to map the inland extent of areas exposed to inundation and erosion hazard is currently underway (December 2021). This analysis will provide much greater detail than this report and will enable improved planning and management of risks.

CHA13	Punakaiki River Beach
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Goss, I. W. (2011) *Review of coastal hazard – Lot 2 DP 336777*, *Punakaiki Beach*, prepared for Punakaiki Farm Ltd by OCEL Consultants NZ Ltd.
Notes	This CHA is based on CHA 8 in the 2000 Regional Coastal Plan (WCRC 2000).

CHA14 Pakiroa (Barrytown) Beach

CHA 14 extends over much of the length of Pakiroa Beach from just north of Burke Road (**BT19 610 287**, 1461060mE 5328700mN) to the southern end of the beach just before 17 Mile Bluff (**BT19 596 180**, 1459640mE 5318010mN). There are many small creeks which discharge into the sea along this CHA including Maher Creek, Deverys Creek, Collins Creek, Canoe Creek, Granite Creek, Fagan Creek and Bakers Creek.

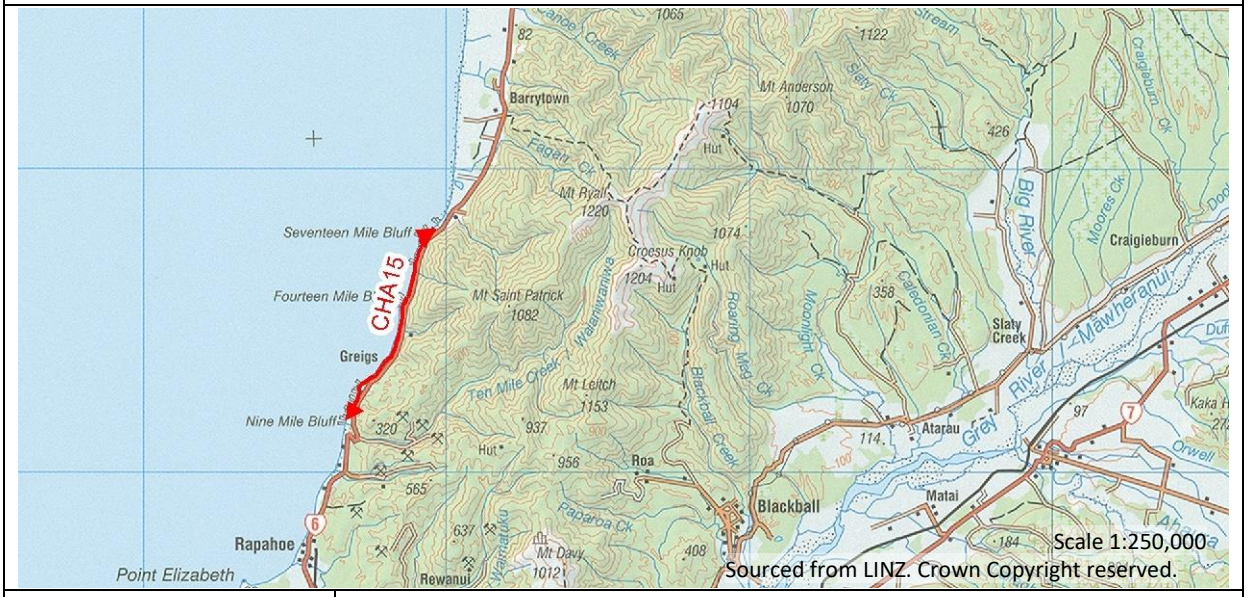


Assets at risk	**Farmland:** Significant areas of farmland are being lost to erosion. **Buildings:** Development pressure is increasing along this stretch of coast. Various new subdivisions are being proposed and constructed. Setbacks are being applied to manage their exposure to the erosion hazard.
Hazard processes	**Erosion:** Long term erosion is the main hazard affecting this CHA. Erosion is being driven primarily by wave driven longshore drift of material from south to north. Erosion rates are highest along the southern to middle parts of the beach with erosion rates reducing further north. There is some accretion at the northern end of the beach. Any management practices which affect sediment delivery or movement along the shore (i.e., groynes, beach mining or seawalls) have potential to impact on erosion rates/patterns. Around creek mouths there are erosion risks associated with mouth migration. **Flooding:** Wave washover flooding affects land behind the beach and flooding can occur at creek mouths due to migration or blockage.
Priority assessment	**Medium:** Erosion rates are high along parts of this CHA and although there are few high value assets currently at risk there is increasing development/subdivision pressure.

CHA14	Pakiroa (Barrytown) Beach
Existing management	Set back of new development to manage erosion threat. Groynes to limit mouth migration of Canoe Creek.
Relevant references	Benn, J. (2004) *Coastal Hazards Assessment: South Pakiroa Beach (Barrytown Flats)*. Report for Paramount Group, Australia (NZ Division) by DTec Consulting Ltd. (Peer reviewed for Grey District Council by Beca Carter Hollings and Ferner Ltd, 2004) Benn, J. and Todd, D. (2005) *Coastal Hazards Assessment: Properties RS 2840, RS 2541, RS 3251, RS 3250; Burke Rd, Barrytown Flats (Pakiroa Beach), Westland.* Report for Punakaiki Downs Ltd by DTec Consulting Ltd. (peer reviewed for Grey District Council by Rick Liefting, Tonkin & Taylor, 2007) Jones, C.J.L. (1992) *Surf Zone Processes and Storm-Induced Beach Profile Response at Barrytown, West Coast, South Island, New Zealand*. Unpublished MSc Thesis, Geography Department, University of Canterbury. 156p.
Notes	This CHA is based on CHA 9 from the 2000 Regional Coastal Plan (WCRC 2000). The northern part of the beach is not included in the CHA as it is either neutral or aggrading at present and there is no existing development at risk. This CHA has been extended slightly to the south to cover the gap that previously was present between CHA 9 and CHA 10. These two CHAs have differing hazard process so have not been combined.

CHA15 17 Mile Bluff to 10 Mile Creek

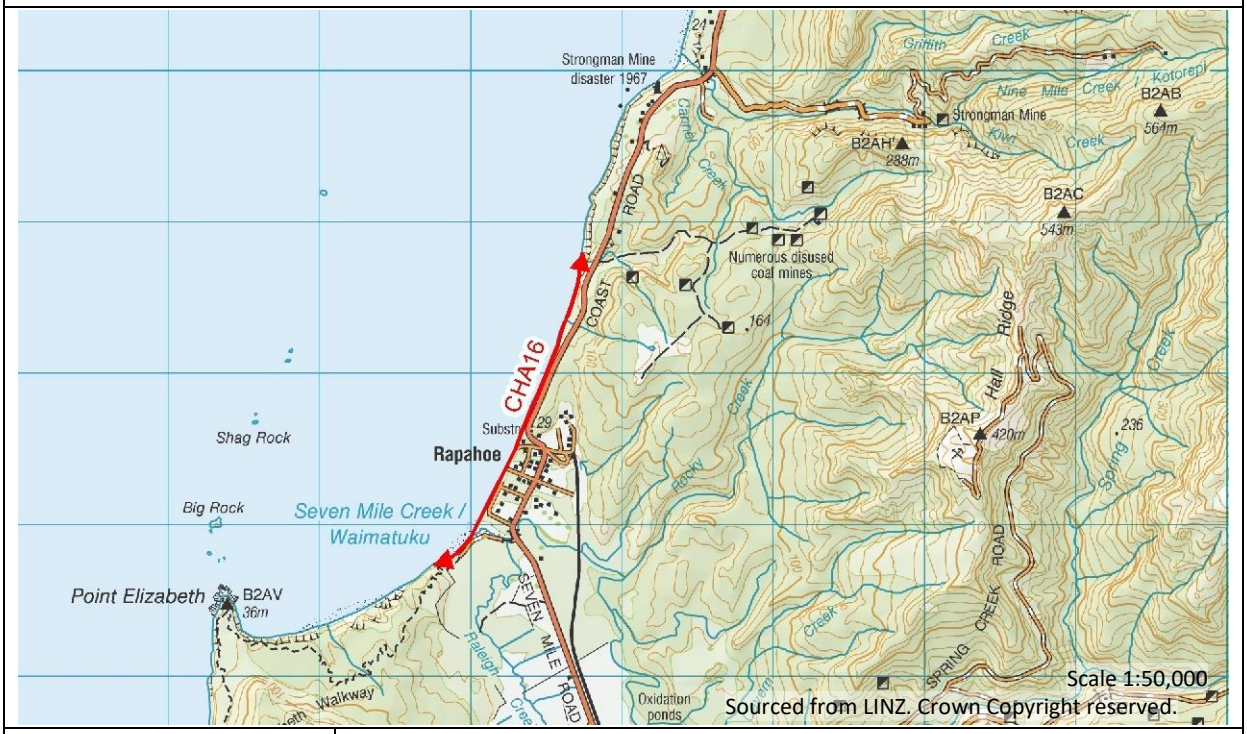
CHA 15 stretches from the end of CHA 14 at 17 Mile Bluff (**BT19 596 180**, 1459640mE 5318010mN) to 10 Mile Creek (**BT19 567 117**, 1456720mE 5311720mN). The CHA includes the small settlement of Greigs.



Assets at risk	**Road:** SH6 is threatened in several locations along this CHA. **Buildings:** Several houses/baches to the west of SH6 are at risk.
Hazard processes	**Erosion:** Erosion of low lying areas fronted by beaches as well as slope erosion of steeper parts of the coastline can affect parts of this CHA. Erosion risk is very variable along the CHA depending on local geology and wave exposure. **Flooding:** Wave washover flooding can affect lower lying portions of this CHA.
Priority assessment	**Low:** Erosion rates are generally low, and the hazard is currently being adequately managed through the use of short sections of armour/seawall.
Existing management	Rock armour has been placed to protect the highway in several locations. At least one house owner has also installed a short section of concrete seawall to protect their property.
Relevant references	Cave, M.P. (2007) *Natural Hazard Assessment of Section 1, 12 Mile Beach Community, Greymouth.* Resource Solutions Todd, D. (2006) *Coastal Hazards Assessment: Wild Weka Limited Property (RS3629), 13 Mile, West Coast*. Report for John and Karen Warren by DTec Consulting Ltd. (Peer reviewed for Grey District Council by I.W. Goss, OCEL Consultants NZ Ltd.)
Notes	This CHA is based on CHA 10 from the 2000 Regional Coastal Plan (WCRC 2000).

CHA16 Rapahoe

The Rapahoe CHA stretches from about 1.5km north of Rapahoe (**BT19 557 088**, 1455740mE 5308810mN) to south of Seven Mile Creek (**BT19 547 067**, 1454750mE 5306740mN).



Assets at risk	**Buildings:** Several properties in Rapahoe are at risk of erosion including residences, the pub and campground. Several undeveloped sections are also at risk. **Road:** SH6 is exposed to erosion for approximately 1km to the north of Rapahoe. Within Rapahoe, Beach Road is already truncated by erosion.
Hazard processes	**Erosion:** Long term erosion of the shoreline is occurring as a result of sand and gravel removal (by northward transport and abrasion) exceeding supply (from Seven Mile Creek, cliff erosion and probably also bypassing around Point Elizabeth from the South). Depletion and rollover occurs on the remnant beach barrier, while wave attack on the bluff at the northern end threatens the stability of the road around the bluff. Creek mouth migration also poses an erosion risk to both the north and south banks of Seven Mile Creek (including parts of the raised terrace to its south). Erosion rates along this CHA vary significantly, predominantly due to the varying exposure to wave energy and direction (due to the sheltering effect of Point Elizabeth). **Flooding**: Wave washover flooding occurs during storms when waves overtop the gravel barrier.
Priority assessment	**High:** On-going processes threaten to erode several properties as well as SH6. Sea flooding will become an increasing problem as more erosion occurs.

CHA16	Rapahoe
Existing management	Rock protection has been installed along parts of the Rapahoe shoreline as well as to protect the highway to the north. NZTA tip debris from landslides on the mudstone bluffs above SH6 north of Rapahoe into the sea providing some limited protection. Detailed analysis to map the inland extent of areas exposed to inundation and erosion hazard is currently underway (December 2021). This analysis will provide much greater detail than this report and will enable improved planning and management of risks.
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Allis, M.J. (2017). Managing and adapting to coastal erosion on the West Coast: Rapahoe 2017 review and update. *NIWA Client Report 2017072HN prepared for West Coast Regional Council*. 16p. Ishikawa, R. (2008) *Historical Shoreline Change and Beach Morphodynamics at Rapahoe Bay, West Coast, New Zealand.* MSc Thesis, Dept. of Geography, University of Canterbury. (peer reviewed for Grey District Council by D Todd). Neale, D. (1999) *Shore Protection Options for Rapahoe Beach – Revised Report.* Report prepared for discussion by the Department of Conservation, Grey District Council and West Coast Regional Council. OCEL Consultants NZ Ltd (2006) Coastal Hazards Assessment: Proposed Subdivision south side of Seven Mile Creek, Rapahoe. Prepared for Tiler Bay Holdings Ltd. (Peer reviewed by D. Todd, DTec Consulting Ltd, 2007) Opus International Consultants (2000) *Rapahoe Protection Works Evaluation*. Report prepared for Grey District Council. April 2000. Pfahlert, J.J. (1984) *Coastal Dynamics and Sedimentation at Point Elizabeth, West Coast, South Island, New Zealand.* MSc Thesis, Dept. of Geography, University of Canterbury. Ramsay, D. (2006) *Managing and adapting to coastal erosion on the West Coast: Rapahoe*, NIWA client report HAM2006-154.
Notes	This CHA is based on CHA 11 from the 2000 Regional Coastal Plan (WCRC 2000). It has been extended slightly to the South to include the coastline just south of Seven Mile Creek as there is proposed development at this location.

CHA17 Cobden

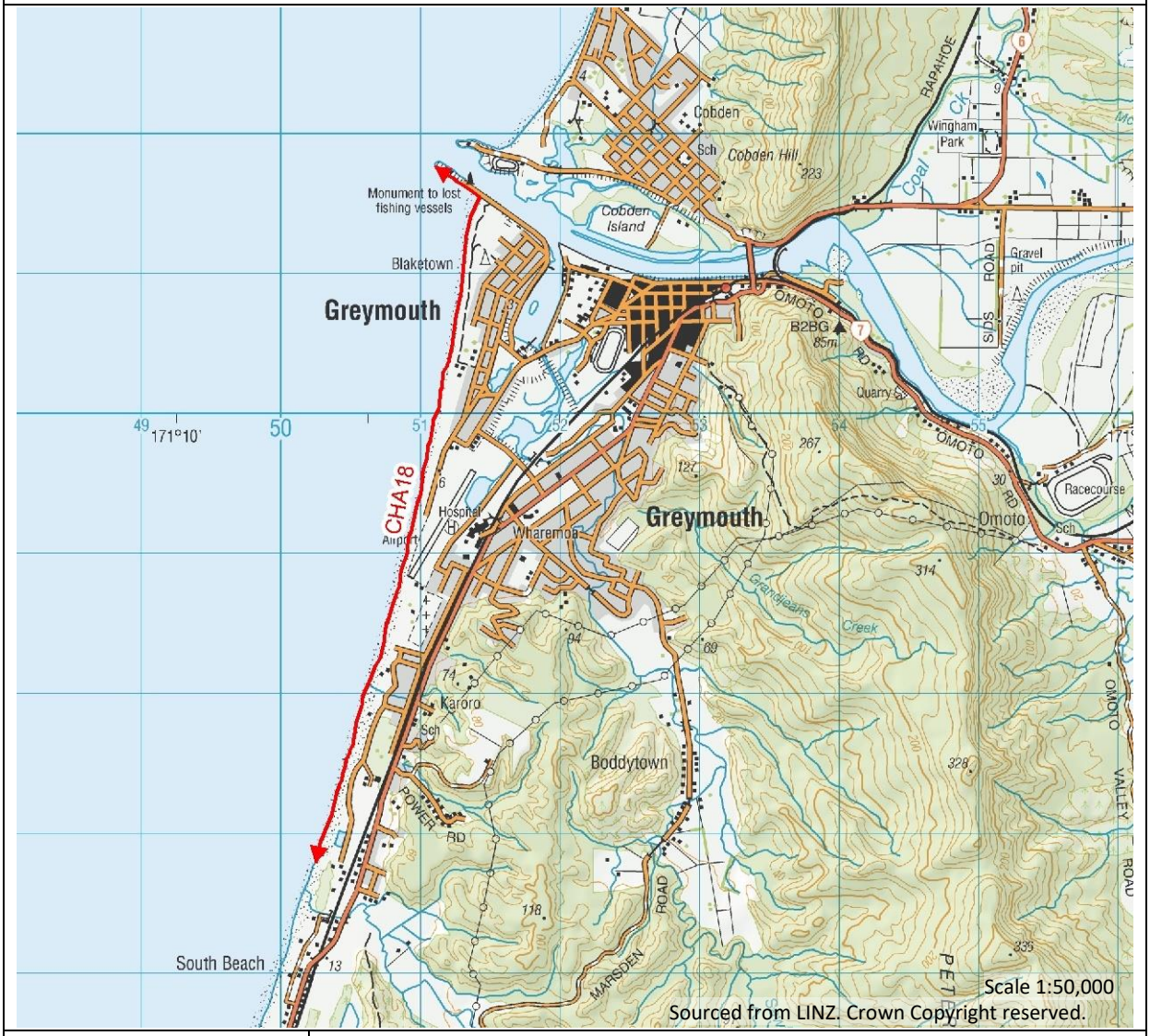
CHA 17 extends from the end of North Beach Road, north of Cobden (**BT19 531 046**, 1453110mE 5304640mN) to the mouth of the Grey River (**BT19 512 999**, 1451260mE 5299950mN). The CHA includes Cobden Beach.

Assets at risk	**Buildings:** Houses in Cobden are threatened by erosion and flooding. **Road:** North Beach Road in Cobden is threatened by erosion and flooding.

CHA17	Cobden
Hazard processes	**Erosion:** Long term erosion of the coastline at Cobden is continuing and is now very close to affecting the road and buildings there. Erosion is driven by an imbalance between the supply of sediment from the Grey River and the coast to the south, and the rate at which sediment is removed from the beach by northward longshore transport and abrasion. **Flooding:** Wave washover flooding threatens the road and properties.
Priority assessment	**Medium:** On-going erosion of this CHA is increasingly threatening North Beach Road and the houses at the north of Cobden.
Existing management	Current management includes maintenance of a bund behind the beach to protect against wave washover flooding. The Grey River training walls have historically had a large effect on the coastal processes in this CHA by interrupting the northward drift of sediment past the Grey River mouth to this CHA. The supply of gravel and sand from the Grey River is complex and may be influenced by floodplain management activities, groynes and gravel extraction.
Relevant references	Allis, M.J (2017) Managing and adapting to coastal erosion at Cobden Beach. *NIWA Client Report 2017137HN prepared for West Coast Regional Council.* 18p. Allis, M.J. (2020) Coastal change at Cobden Beach, Greymouth. *NIWA Client report 2020092HN Prepared for West Coast Regional Council*. 23p
Recommendations	**Development of hazard zones for this CHA is recommended**. Analysis of historic aerial photography, shoreline profiles and photogrammetry should be carried out in order to develop hazard zones defining the landward extent of the area threatened by erosion. Hazard zones will allow assessment of the number of existing properties at risk within specific timeframes and will enable the development of management plans for these properties as well as informing appropriate setbacks for new development proposals. Some inundation mapping is underway for this CHA by Land River Sea Consulting Ltd (as of December 2021), however this is not planned to include erosion hazard.
Notes	This CHA covers half of CHA 12 from the 2000 Regional Coastal Plan (WCRC 2000). CHA 12 was split, creating new CHAs for Cobden and Blaketown separately, because the processes affecting the two areas are different.

CHA18 Blaketown to Karoro

CHA 18 extends from the mouth of the Grey River (**BT19 511 997**, 1451100mE 5299770mN) to between Karoro and South Beach (**BU19 502 947**, 1450250mE 5294790mN). The CHA includes Blaketown Beach.



Assets at risk	**Airport**: The corner of the Greymouth airport runway enclosure at Karoro is threatened with erosion. **Recreation:** Blaketown beach access is affected by erosion **Buildings:** Few buildings are currently threatened by erosion although this is a heavily developed CHA and any long-term erosion would cause significant problems.

CHA18	Blaketown to Karoro
Hazard processes	**Erosion:** Recently, parts of the beach have experienced short term erosion, especially adjacent to the airport runway at Karoro. The causes of this erosion are not fully understood. **Down-drift effects:** Due to the predominantly South to North drift of sediment, actions in this CHA may affect CHA 17. However, the degree of connectivity between these CHAs, past the Grey River and its training Walls, is not firmly established.
Priority assessment	**Medium:** There are few assets currently impacted in this CHA but any long term erosion would have significant consequences. There is some uncertainty over the degree to which actions in this CHA affect CHA 17.
Existing management	The Grey River training walls have historically had a large effect on the coastal processes in this CHA. Current management includes gravel extraction from Blaketown Beach. There are no coastal defences in this CHA.
Relevant references	Benn, J. (2007) *Coastal Stability and Beach Gravel Extraction at Greymouth*. Report for Westroads Ltd (Greymouth) by DTec Consulting Ltd Benn, J. and Todd, D. (2003) *Effects of Beach Gravel Mining in the Greymouth Environs*. Report for Department of Conservation, Hokitika by DTec Consulting Ltd. NIWA (2006) *Impacts of gravel removal from the coastline between Paroa and Blaketown*, Information brochure produced for West Coast Regional Council.
Recommendations	**Continued monitoring of shoreline changes in this CHA is recommended.** Monitoring will allow improved understanding of coastal processes and impacts of gravel extraction. **Further research into the effects of gravel mining and the Grey River training walls is recommended.** There is little information about the degree to which sediment from this CHA bypasses the Grey River training walls and is delivered to CHA 17. Research to better understand this process would be very valuable to decision making in both CHA 17 and CHA 18.
Notes	This CHA covers half of CHA 12 from the 2000 Regional Coastal Plan (WCRC 2000). CHA 12 was split, creating new CHAs for Cobden and Blaketown separately, because the processes affecting the two areas are different.. However, it is worth bearing in mind that there may be linkages between this CHA and the one immediately north due to the generally south-north direction of longshore sediment transport.

CHA19 South Beach to Camerons

CHA19 covers the stretch of coast from north of South Beach (**BU19 502 947**, 1450250mE 5294790mN) to Camerons (**BU19 469 871**, 1446960mE 5287180mN) including Paroa and Gladstone. CHA19 includes the mouth of the New River / Kaimata.

Assets at risk	**Buildings:** Several properties including the school, hotel and houses have been affected by flooding. **Road:** SH6 and local roads have been affected by flooding in the past. **Recreation:** Wave washover during storms can damage the access road. Previously recreational access to the beach was restricted during periods when the river mouth had migrated a long way north.
Hazard processes	**Flooding:** Flooding caused by mouth migration and/or partial/full closure of the New River / Kaimata mouth presents a significant risk along this

CHA19	South Beach to Camerons
	CHA. River floods can cause flooding to properties in Paroa when the mouth has migrated a long distance northwards or is partially closed. **Erosion:** Erosion can occur during mouth migration when the river is forced to extend parallel to the shore. As wave driven longshore transport deposits material into one side of the river mouth, the river erodes land on the opposite side of the mouth and extends the lagoon. Erosion has historically been less of a problem than flooding. Historically, the mouth of the New River / Kaimata has migrated over almost the full length of this CHA. Currently there is little erosion risk as the mouth is prevented from northward migration, although the rock bund itself is at risk of erosion during severe river flows and waves.
Priority assessment	**Medium:** Although there has been property and road flooding in the past, the current channel management regime appears to have reduced the flood risk significantly.
Existing management	The rating district maintains the mouth at its current location by constructing and maintaining a rock armoured bund/groyne to prevent northward mouth migration. To prevent flooding they also mechanically open the mouth when water levels reach a trigger level.
Relevant references	Smart, G. (2010) *Report on the River Mouth Situation at Paroa*. West Coast Regional Council (2011) *Report on West Coast Weather Event 27 & 28 December 2010*.
Notes	This CHA was established as part of the 2012 review of coastal hazard areas. It has been separated from CHA18 due to the different hazard processes at this location. It should be noted that due to the predominantly northward drift of sediment at this location management practices in this CHA have the potential to influence CHA18.

CHA20 Taramakau to Arahura

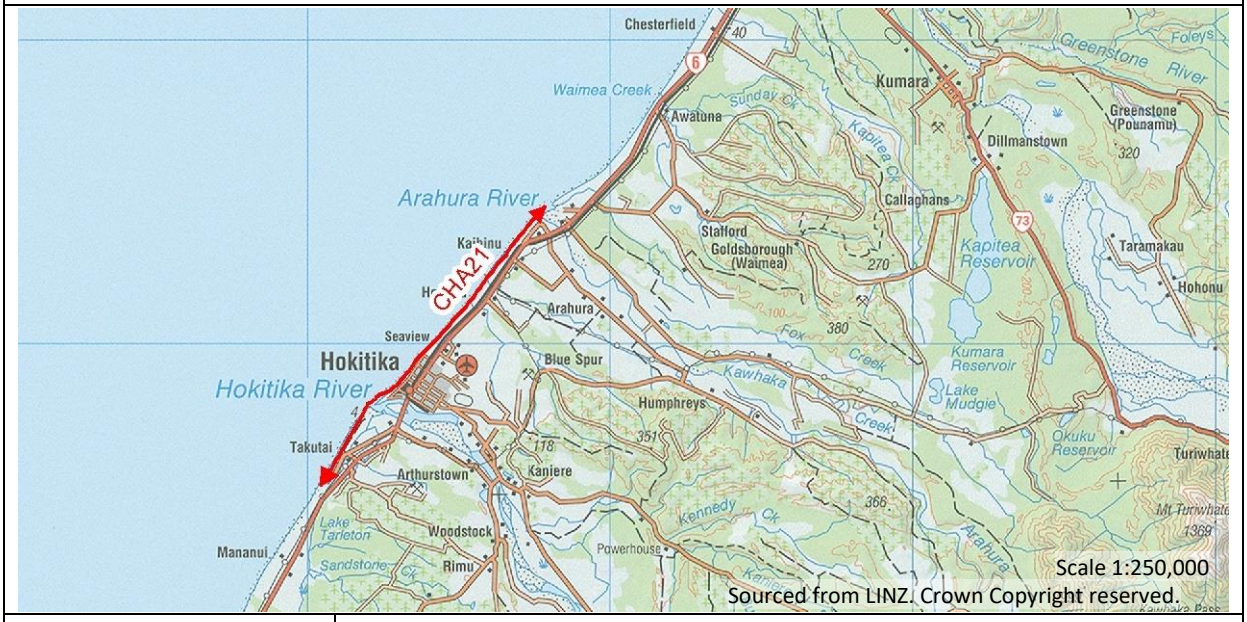
This CHA extends from north of the Taramakau River (**BU19 469 871**, 1446960mE 5287170mN) to the south side of the Arahura River mouth (**BU18 378 745**, 1437890mE 5274540mN) including Waimea Creek, Chesterfield and Awatuna.

Assets at risk	**Road:** Serpentine Road immediately south of the Taramakau is at risk of erosion. The northern end of this road is no longer maintained. **Farmland**: Farmland on the both sides of the Taramakau mouth and along the coast between the Taramakau and Arahura Rivers is at risk from erosion. **Buildings**: There are currently 2-3 buildings within 100 m of the beach around the Awatuna/Waimea Creek area.
Hazard processes	**Erosion:** Movement of the Taramakau River mouth can cause erosion on either the south or north banks. Prior to 2006 the mouth was offset to the south and caused erosion of farmland and loss of two houses. Before the late 1990's the mouth flowed to the north with significant erosion affecting the north bank. Migration of the mouths of the Arahura River and the smaller creeks such as Serpentine Creek and Waimea Creek can also cause erosion. Northern mouth migration of Serpentine Creek has previously threatened the bend on Serpentine Road. There is also some risk of coastal erosion away from the river mouths. While there is scant information regarding any long-term erosion trend, short-term (months to decades) erosion/accretion cycles are expected associated with storm and recovery cycles and transient imbalances

CHA20	Taramakau to Arahura
	between sediment supply from the Arahura River and further south and losses due to northward longshore transport and abrasion. Little analysis of open coast erosion along this section of coast is currently available. **Flooding:** Flooding due to storm waves affects parts of this CHA. Constriction or closure of creek mouths can also cause flooding.
Priority assessment	**Low:** There are few assets at risk and no management is currently carried out.
Existing management	Gravel extraction occurs on the Taramakau River between the road/rail bridge and the coast. Previously rock protection and works to relocate the Taramakau mouth to manage erosion risk have been undertaken but past consents for these activities have expired. In 1996 groynes and riprap were installed to protect the bend on Serpentine Road from erosion by northward migration of Serpentine Creek. At the same time works were undertaken to relocate the mouth more centrally. These works have been successful in protecting the road.
Relevant references	Benn, J. (2004) *Coastal Stability and Potential Effects of Extraction on the Paroa – Taramakau Beach: Resource Consent Application RC04008.* Report for West Coast Regional Council by DTec Consulting Ltd. Benn, J. (2006) *Potential physical effects on the Taramakau-Blaketown Beach due to sediment removal associated with a proposed artificial opening of the Taramakau River Mouth*. Report for I.G. Lee by DTec Consulting Ltd.
Notes	This CHA is based on CHA 13 from the 2000 Regional Coastal Plan (WCRC 2000). The Taramakau River is an important sediment supply to the coast north of this CHA.

CHA21 Hokitika

CHA21 extends from the south side of the Arahura River, north of Hokitika (**BU18 378 745**, 1437890mE 5274540mN) to level with the end of Golf Links Road, south of Hokitika (**BU18 304 653**, 1430430mE 5265310mN). This CHA includes Hokitika and the Hokitika River mouth.



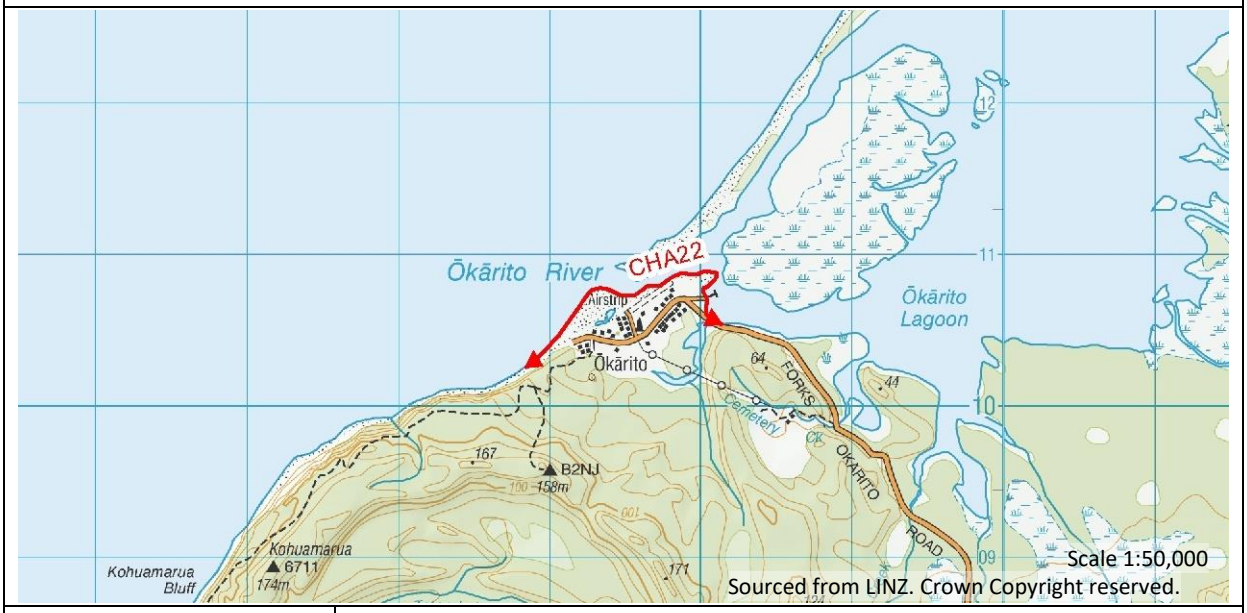
Assets at risk	**Buildings:** Parts of the town as well as industrial land and some dwellings on the north of the town are at risk. **Recreation:** Hokitika beach access, parking and facilities are at risk from coastal hazards. The Sunset Point spit-head is also at risk of erosion, including the historic Tambo Shipwreck. **Road:** SH6 is not threatened in this CHA but various minor roads are at risk. **Farmland:** Farmland north and south of Hokitika is affected by coastal processes.
Hazard processes	**Erosion:** The position of the coastline at Hokitika has historically experienced fluctuations of up to 200m over years to decadal time scales. Erosional and accretional phases tend to migrate northwards and are influenced by the position and orientation of the river mouth. There has been little long-term trend in erosion or accretion observed at Hokitika. During phases of erosion, rapid retreat of the coastline can occur. North of Hokitika, around Houhou Creek, migration of the creek mouth can cause erosion from the creek or by allowing waves to attack the backshore. **Flooding:** Wave washover flooding can impact land immediately behind the beach. **Dune Blowouts:** Dune blowouts can occur as a result of wave/wind action during storms, particularly in the southern part of this CHA.

CHA21	Hokitika
Priority assessment	**High:** There are many high value assets at risk on a very dynamic coastline. Current management practices seem to be reasonably effective at managing the erosion risk.
Existing management	A number of rock groynes have been installed along the Hokitika seafront to help maintain a consistent shoreline position. A raised rock-faced bund has been created along much of the Hokitika town sea-front to prevent wave washover flooding and act as a backstop during erosion episodes. Rock protection has been placed around the spit-head on the north side of the Hokitika River Mouth and extended North to protect the Tambo Shipwreck. Stopbanks along the river provide protection from river flooding.
Relevant references	Daniel, Robert. J., (1998) *Proposal for extension of the rock groyne field on the Hokitika beach front, to protect against future sea erosion*. Westland District Council. Daniel, Robert. J, (2004) *Evidence in the matter of resource consent application RC04049 to the West Coast Regional Council and resource consent application 040043 to the Westland District Council to construct and maintain coastal erosion works (rock groynes)*. Gibb, J. G. (1987) A Coastal Hazard Management Plan for Hokitika. *Water and Soil Technical Publication No. 29* Hicks, D. M. (1988) *Uplift, Sea Level Rise, Shoreline Stability and Hazard Management at Hokitika*. Report to Hokitika Borough Council. Water Sciences Division D.S.I.R. Hicks, D. M. (2003) *Impacts of Stone Harvesting from the Houhou-Kaihinu foreshore*. *NIWA Client Report CHC2003-090 prepared for Stoneweavers Ltd,.* Hicks, D. M. (2011) Coastal Hazards Assessment for Houhou Creek area. *NIWA Client Report CHC2011-028 for Watersedge Stoneweavers Ltd* Hicks D.M. (2016) Rivermouth-related shore erosion at Hokitika and Neils Beach, Westland. *NIWA Client Report CHC2016-002* p*repared for West Coast Regional Council.* Todd, D. and Benn, J. (2010) *Coastal Hazard Assessment: Westmeats Ltd, Lot 20, DP 33; State Highway 6, Hokitika*. Report for Westmeats Ltd by DTec Consulting Ltd. Westland Catchment Board (1986) *Chronological List of Past Episodes of Sea Erosion at Hokitika* Westland Catchment Board and Regional Water Board (1984) *Hokitika Beachfront Sea Erosion*
Recommendations	**Development of hazard zones for this CHA is recommended**. An updated photogrammetric analysis of historic aerial photography and shore profiles should be carried out in order to develop hazard zones defining the landward extent of the area threatened by erosion – notably beyond

CHA21	Hokitika
	the protective influence of the groyne field. Hazard zones will inform appropriate setbacks for new development proposals and aid decision making on consent applications. Some inundation mapping is underway for this CHA by Land River Sea Consulting Ltd (as of December 2021), however this is not planned to include erosion hazard.
Notes	This CHA is based on CHA 14 from the 2000 Regional Coastal Plan (WCRC 2000). There is little change to the CHA extents or the processes affecting it. Land to the south of this CHA is affected by hazard processes (erosion, flooding and dune blowouts) but the CHA has not been extended due to the low density of built assets (buildings, roads, etc) although areas of farmland are threatened.

CHA22 Ōkārito

This CHA covers the south side of the Ōkārito Lagoon mouth, around the settlement of Ōkārito (**BW15 701 105**, 1370140mE 5210540mN to **BW15 688 102**, 1368830mE 5210250mN).



Assets at risk	**Buildings:** Parts of Ōkārito settlement are at risk from flooding and erosion including houses, hostels, campground and the airstrip. **Road:** Roads within Ōkārito are affected by flooding. **Recreation:** Recreation opportunities are affected by flooding, including historic sites and tourist accommodation.
Hazard processes	**Flooding:** Flooding from the Ōkārito Lagoon occurs due to closure of the lagoon mouth. The lagoon can close when waves drive sediment across the mouth. **Erosion:** Lagoon mouth migration can cause erosion.
Priority assessment	**Medium:** A moderate number of assets are affected by flooding from the lagoon, artificial opening of the lagoon mouth is used to manage this risk.
Existing management	Since 1993 there has been a consent to mechanically open the Ōkārito lagoon mouth to alleviate lagoon flooding. Culverts are in place to connect the low-lying land behind the main settlement with the lagoon. Localised rock protection has been placed at the culvert entrance/exits.
Notes	This CHA is based on CHA 15 from the 2000 Regional Coastal Plan (WCRC 2000). The extents of the CHA have been slightly adjusted to better represent the hazard area (the hazard area is focussed on the assets although the hazard processes extend throughout the whole lagoon).

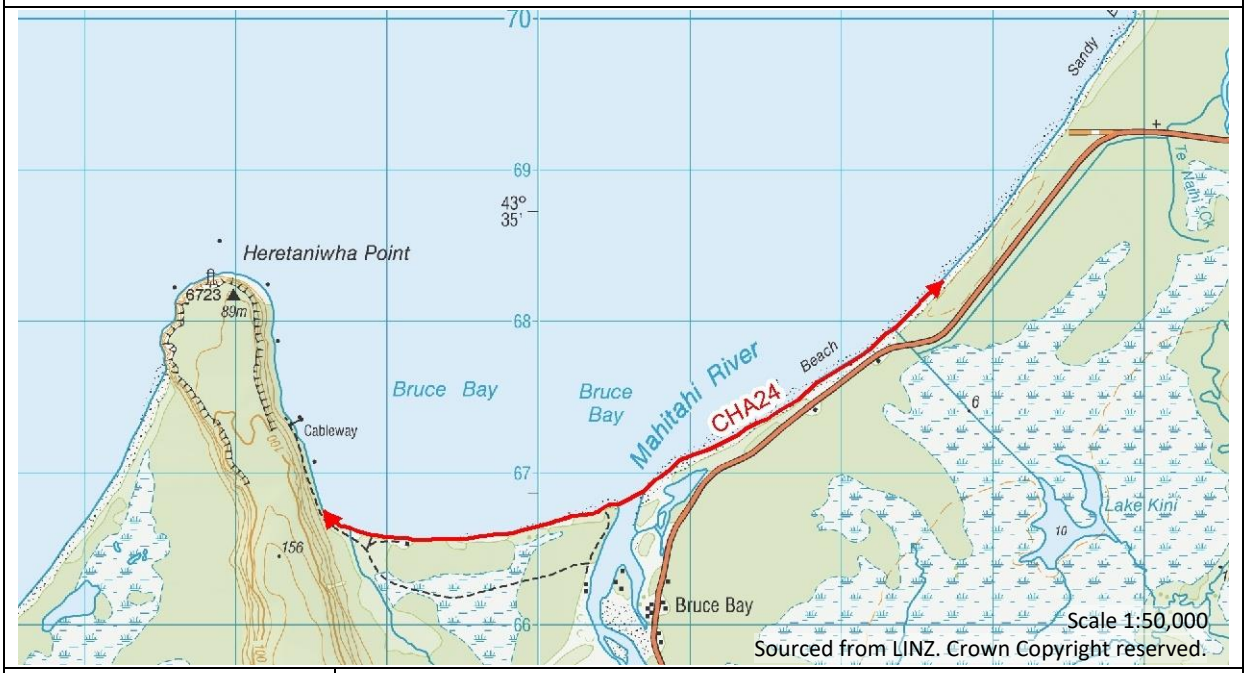
CHA23 Hunts Beach

CHA 23 covers the developed part of Hunts Beach from **BX14 322 729** (1332250mE 5172970mN) to **BX14 312 721** (1331260mE 5172180mN).

Assets at risk	**Buildings:** The settlement at Hunts Beach is becoming more threatened by flooding as the coast continues to erode.
Hazard processes	**Flooding:** Flooding by wave washover affects land behind the beach. During ex-cyclone Fehi flooding caused severe property damage. **Erosion:** Erosion by storm waves and mouth migration can affect Hunts beach. Erosion of the shoreline has been observed over at least the past 25 years.
Priority assessment	**Low:** Whilst Hunts Beach experiences high hazard there are relatively few assets at risk.
Existing management	Parts of the shoreline are protected with a raised earth bund and vegetation has been planted to help maintain it.
Notes	This CHA is based on CHA 16 from the 2000 Regional Coastal Plan (WCRC 2000).

CHA24 Bruce Bay

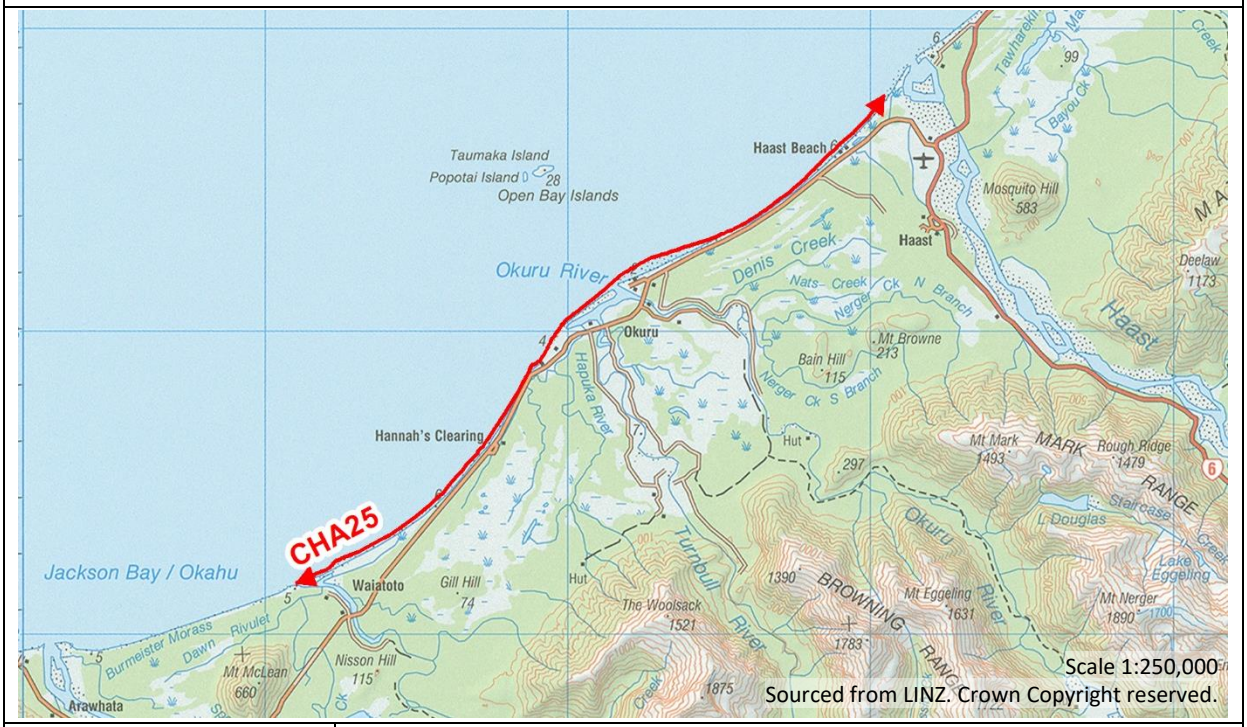
CHA 24 covers the southern part of Bruce Bay including the mouth of Mahitahi River. The CHA extends from **BX14 266 682** (1326670mE 5168280mN) to **BX13 225 667** (1322570mE 5166760mN).



Assets at risk	**Road:** Approximately 2 km of SH6 runs close behind the beach and is threatened by erosion and flooding. There was severe damage to SH6 during Fehi, with the road washing out. **Buildings:** Properties (Marae and fishing cabin) on the landward side of SH6 are threatened by wave washover flooding.
Hazard processes	**Erosion:** Long term erosion of the coast is occurring as well as cyclic changes associated with changes in the position of the Mahitahi River mouth. Erosion by river flows due to mouth migration can affect the highway adjacent to the mouth. **Flooding:** Wave washover flooding can affect the highway and properties during storms.
Priority assessment	**Low:** Hazards are severe but other than SH6 there are few assets at risk.
Existing management	Rock protection/seawall has been used to protect the highway from coastal erosion and river erosion due to river mouth migration.
Relevant references	Opus International Consultants Limited (2005) *Proposed Seawall - Coastal Morphodynamic Assessment Bruce Bay – Westland* for Transit NZ.
Notes	This CHA is based on CHA 17 from the 2000 Regional Coastal Plan (WCRC 2000).

CHA25 Haast Beach to Waiatoto

CHA 25 extends from the south bank of the Haast River (**BY11 804 377**, 1280500mE 5137780mN) to the southern limit of the Waiatoto Lagoon (**BY11 610 216**, 1261020mE 5121650mN). The CHA includes the settlements of Haast Beach, Okuru and Hannahs Clearing.

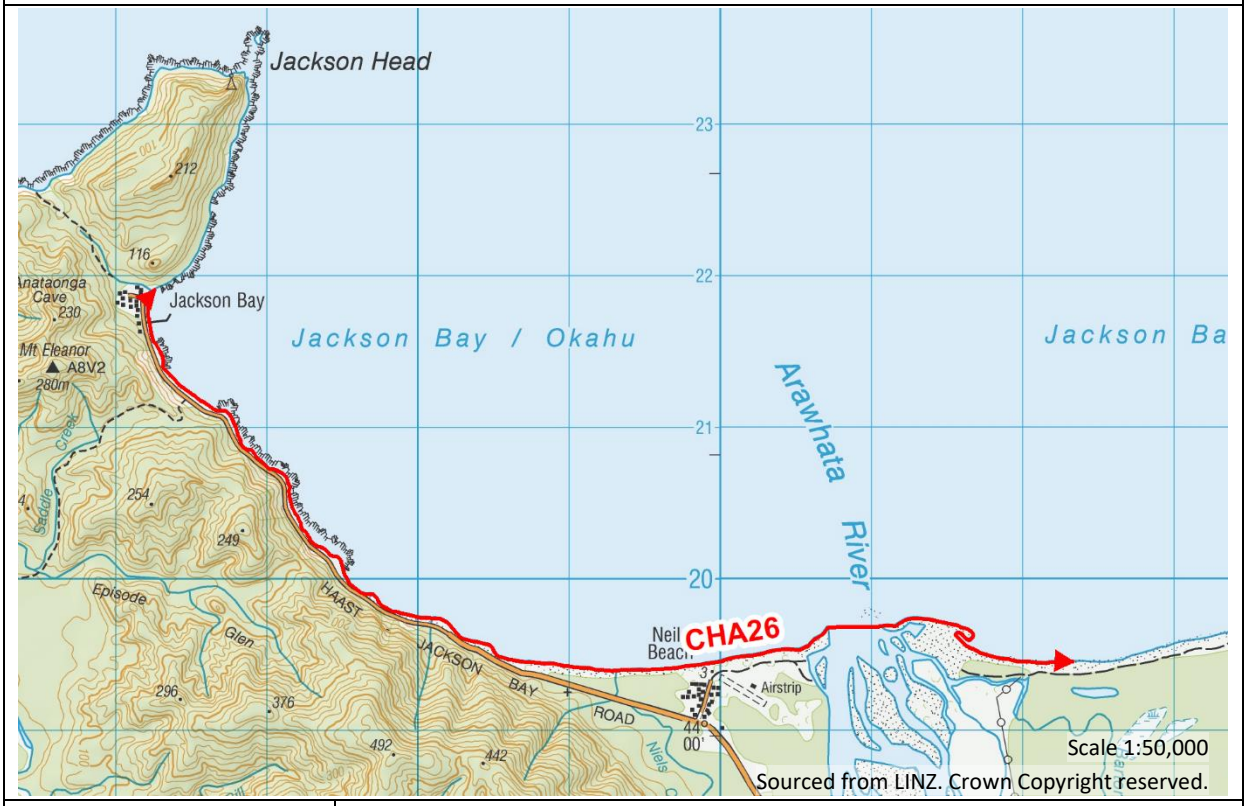


Assets at risk	**Buildings:** Various residences and undeveloped subdivisions in Okuru are at risk on both the north and south sides of the Okuru Lagoon backshore. **Infrastructure:** Power pylons on the Waiatoto Lagoon backshore have previously been affected by erosion. The rubbish tip south of Hannahs Clearing has also been threatened with erosion. **Farmland**: Farmland along this CHA is affected by erosion. **Road:** Parts of the Jackson Bay Road pass close to the shoreline and/or lagoon backshore and could be threatened by erosion in the future.
Hazard processes	**Erosion:** The mouths of the Okuru/Turnbull/Hapuka Rivers and Waiatoto River both migrate over several kilometres of separate sections of this CHA. At both lagoons the position of the river mouth can change the exposure of the lagoon backshore to river flows and wave action which in turn can cause erosion. In addition to erosion as a result of river mouth migration there is also erosion of the open coast on this CHA. **Flooding:** Lagoon mouth closure can cause flooding of low-lying land and buildings around the lagoons. Wave washover flooding affects parts of this CHA. **Dune blowouts:** The beach is backed by dunes, and dune blowouts can occur as a result of wave/wind action during storms.

CHA25	Haast Beach to Waiatoto
Priority assessment	**Medium:** Past episodes of erosion have seriously threatened residences in Okuru, the Hannahs Clearing rubbish dump, and the power lines at Waiatoto Lagoon.
Existing management	Rock erosion protection has been installed along parts of the Okuru Lagoon backshore to protect residences and undeveloped subdivisions. Rock protection has been installed to protect Hannahs Clearing rubbish dump. Mechanical opening of the Waiatoto Lagoon mouth is carried out to reposition the mouth opening to protect power lines from erosion.
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. B F Whitham Ltd and Lakes Consulting Group (2006) *Assessment of Environmental Effects: Rock Seawall at Okuru*. (Peer reviewed for West Coast Regional Council by OCEL Consultants Ltd.) Moen, W. (2004) *Coastal Hazard Assessment: Mussel Point Okuru.* Report for Cowan & Holmes Ltd by West Coast Regional Council. MWH (2007) *Waiatoto River Mouth Channel Works, Resource Consent Application and Supporting Information*. Report for New Zealand Energy Ltd.
Notes	This CHA is based on CHA 18 from the 2000 Regional Coastal Plan (WCRC 2000). It was extended in December 2021 to include Haast Beach.

CHA26 Neils Beach to Jackson Bay

CHA 26 extends from east of the Arawhata River (**BY11 543 195**, 1254330mE 5119460mN) to Jacksons Bay (**BY10 482 219**, 1248260mE 5121920mN).



Assets at risk	**Buildings:** Neils Beach has approximately 15 houses. The properties most at risk are approximately 80 m from the current high tide mark (Oct 2015). In Jackson Bay township several low-lying buildings are at risk of inundation. **Infrastructure:** The north end of the Neils Beach airstrip is within approximately 30m of the beach and is at risk of erosion if the current trend continues **Farmland**: There is little actively farmed land around Neils Beach. A small paddock owned by a Maori Trust exists between the houses and the beach and is being actively eroded (Oct 2015). **Road:** From approximately 1 km West of the Neils Beach turning the Jackson Bay Road passes close to the shoreline and is threatened by erosion. The informal access track from Neils Beach to the Arawhata River mouth has been eroded in places.
Hazard processes	**Erosion:** The main hazard affecting Neils Beach is erosion. Over the period 2010-2015 the shoreline at Neils Beach experienced high erosion rates of 3-4 m per year but prior to this the shoreline was much more stable. There is little/no sediment supply passing around Jackson head from the south so the only sediment supplies to this stretch of coastline are from local landslides/streams between Jacksons Bay and Neils Beach

CHA26	Neils Beach to Jackson Bay
	and the Arawhata River. For this reason, the stability of the shoreline is very dependent on the position and orientation of the Arawhata mouth and its recent flood history. A westerly mouth location appears to encourage sediment storage on Neils Beach while an easterly mouth "drains" this storage and promotes erosion. It is unclear to what extent the current erosion is part of short-term variability due to river mouth processes or a longer-term trend (e.g. driven by a waning sediment supplies or sea-level rise). Erosion potential at Jacksons Bay township is limited by existing rock/rubble walls, but erosion potential will increase with sea level rise. **Flooding:** There is likely a risk of flooding from the Arawhata River, particularly if the mouth is constricted by a high beach barrier which is not rapidly eroded on the rising limb of a flood. Also, the risk of sea-flooding will increase if the erosion of the foredune fronting the Neils Beach village continues. This is because locally the erosion has already removed the dune crest, lowering the natural protective barrier. Flooding is the main hazard in Jackson Bay township. High sea levels will flood up Seacombe Creek onto the adjoining roads, carpark, and the private property alongside Pier Street.
Priority assessment	**Medium:** The current erosion rate is high and is starting to threaten parts of the road and runway. There is still a reasonable buffer before any houses will be directly affected by erosion.
Existing management	Sacrificial Bunds have been constructed along parts of the Neils Beach coastal area to help reduce the rate of erosion. Some reactive maintenance of the Jacksons Bay Road west of Neils Beach has been carried out. Rock and concrete rubble walls along the coast at Jackson Bay township limit erosion.
Relevant references	Allis, M., Bosserelle, C., Gardner, M. (in production) Assessment of High Coastal Hazard Areas for the West Coast: Supporting Te Tai o Poutini. NIWA report to West Coast Regional Council. Hicks D.M. (2016) Rivermouth-related shore erosion at Hokitika and Neils Beach, Westland. *NIWA Client Report CHC2016-002 prepared for West Coast Regional Council*. Phelps C., (2016) *Resource Consent Application for West Coast Regional Council – Beach Nourishment and Sacrificial Bund*. VCS Environmental December 2016.
Notes	This CHA was added as part of revisions to this report in November 2015. The CHA was extended to include Jackson Bay in December 2021.

4 Discussion and recommendations

4.1 Discussion

In developing the recommended CHAs in Section 3 of this report, we have considered evidence from literature, observations made in actual and virtual field trips, and other reports or studies of relevance. In this review we have focussed on the lateral extent of hazard areas along the coast. We have not considered 'zones' or 'setbacks', i.e., the landward extent of these hazard areas, as the scope of this review was to look at hazards in the Coastal Marine Area (CMA) only (up to MHWS). However, as noted in Section 2, the NZCPS and sea-level rise guidance together indicate that the CMA is not static and may advance inland in the future. Thus, future work may be required to properly map the landward extents of some high priority hazard 'zones' to allow for adaptation to sea-level rise. In this regard, WCRC may wish to provide comment in the West Coast RPS, when that document is next reviewed, that encourages thinking ahead to 2115 for the management of coastal hazards within *and* above the CMA.

We further note with regard to climate change information that while some of the existing literature used in this CHA review considers climate change effects, many of these studies were done prior to NZCPS 2010 being gazetted. It is assumed such work therefore might not have considered climate change effects through to 2115.

With regard to CHA prioritisation, we note that the coastal hazard assessment approach advocated by MfE (2017a and b) encourages:

- region-wide hazard-exposure screening to guide priorities, followed by
- More in-depth assessments in high priority hazard areas to feed into community engagement processes, risk and vulnerability assessments and detailed land use planning.

For the purposes of this review, we carried out a simple qualitative prioritisation of CHAs based on 'expert opinion' assessment of coastal processes and assets at risk (Section 2.3). This can be considered a 'region-wide hazard-exposure screening' approach. Part of this review has involved prioritising hazard areas for more in-depth assessments. It should also be noted that the MfE guidance does recognise that "*In the absence of detailed site-specific hazard assessments, a region-wide hazard assessment is useful in its own right to support land-use planning and adaptation planning processes for managing hazard risk across a region or district*". In line with this guidance it is appropriate that where more detailed hazard assessments are not yet available the CHAs recommended in this review should be used to support land use planning and adaptation planning processes.

4.2 Recommendations

We recommend that:

1. The CHAs presented in Section 3 are included in the revised Regional Coastal Plan for the West Coast. The tables and maps may be directly inserted as a schedule of the plan, although the notes section of the tables may be deleted first.

2. CHA priorities given in Section 3 should be considered a 'first-pass', and any further work that may be undertaken should be used to re-assess those priorities as appropriate.

3. Where this review has identified CHAs as *high priority*, further work should be undertaken to fully assess (i.e., following a full risk management approach) the risks posed by coastal hazards in that CHA. A staged approach to this may be necessary to prioritise work in the most cost-effective manner for WCRC.

4. Further work is undertaken for CHAs *where we have recommended development of hazard zones*. In general, for hazard zones where erosion risk is a significant hazard this should involve analysis of historic aerial photography and any existing shore profile data and LiDAR to develop hazard zones defining the landward extent of the area threatened by short-term and long-term erosion. For areas where there is significant flood risk LiDAR data should be used to define hazard zones for low lying areas vulnerable to storm tides and wave setup. We understand that LiDAR data collection for large parts of the West Coast Region has been funded and will be available in the near future (starting to become available for some areas as of December 2021). Hazard zones will allow assessment of the number of existing properties at risk within specific timeframes and will enable the development of management plans for these properties as well as informing appropriate setbacks for new development proposals.

As outlined in section 4.1 above, other future work (and a longer-term programme of work) to better understand coastal hazards on the West Coast could be conducted, including investigations in high priority CHAs to bring together sea-level rise estimates and other predicted climate change induced changes to the coastal environment. These could include looking at potential changes to flooding extent due to storm-waves and storm surge, changes in coastal erosion (shoreline position), river-mouth blocking, and the exacerbation of these by rising sea level.

5 Bibliography

In addition to the specific references listed for each CHA the following references provide useful information on more than one CHA:

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