Resilient ORGANISATIONS

URBAN INTELLIGENCE

RISK SCREENING

Rīpoata Tautuhi Mōrearea

FIRST PASS CLIMATE CHANGE RISK ASSESSMENT

Prepared for the
Buller District Council's
Climate Change Adaptation Planning Programme

First-Pass Climate Change Risk Assessment

Prepared for: Buller District Council

Prepared by: Urban Intelligence Ltd. and Resilient Organisations Ltd.

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Version 1.0	Draft report	17/08/2022
Version 1.1	Updated report, restructuring the elements	01/09/2022
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Quality Assurance Statement		
	Reviewed by:	Dr Tracy Hatton, Resilient Organisations Ltd

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Glossary | Kuputaka

	DEFINITION
Adaptation	The process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2014).
Adaptive capacity	The ability to respond to hazards.
Climate-influenced hazards	Natural hazards that may change in severity or frequency as a result of climate change and associated environmental change.
Domain	Wellbeing or value domains are a hybrid of the NZ Treasury's Living Standards Framework and group values, assets, and systems that could be affected by climate change.
Element	The assets, taonga, people, places, and specific systems that may be at risk. These are grouped into subdomains.
Exposure	The potential to be impacted by hazards.
IPCC	Intergovernmental Panel on Climate Change. This is a United Nations body for assessing the science related to climate change and is the world's foremost authority on climate change.
NAP	National Adaptation Plan
NCCRA	National Climate Change Risk Assessment
Physical risk	Risk arising from either acute (extreme weather) or chronic (increased temperature, sea level etc.) impacts as a result of climatic change.
RCP	Representative Concentration Pathway. Representing various climate change scenarios based on differing levels of atmospheric carbon. These have been largely superseded by SSPs.
Risk	The outcomes (positive and negative) and associated uncertainties, with respect to something that humans value (SRA, 2015).
Sensitivity	The degree to which something is impacted by hazards.
SSP	Shared Socioeconomic Pathway. Representing scenarios where emission reductions will, or will not, be achieved. These have largely replaced the RCPs in recent IPCC reports.
Subdomain	These are groupings of elements to reflect risks. For example, the subdomain "transportation" (in the Built domain) would include roads and other assets.
TTPP	Te Tai o Poutini Plan (TTPP) is the combined District Plan for the Buller, Grey and Westland District Councils.
Transition risk	Risk arising from the economy's shift towards low emissions.
Vulnerability	The degree to which an element is susceptible to damage, based on its exposure.

DOMAINS	
Built environment	Vertical (e.g., buildings) and horizontal (e.g., roads, electricity) infrastructure.
Economy	Set and arrangement of inter-related production, distribution, trade, and consumption that allocate resources.
Governance	The governing architecture and processes in and between governments, and economic and social institutions.
Human	Direct and indirect impacts on people.
Kaupapa Māori	Direct and indirect impacts on Tangata Whenua and taonga.
Natural environment	Aspects of the natural environment that support the range of our indigenous species, he kura taiao (living treasures), the ecosystems, and our blue-green infrastructure.

Executive summary | Whakarāpopototanga

Climate change is already impacting the Buller District. As a result, the Buller District Council has begun its climate change adaptation planning programme as part of the Long-Term Plan (2021-2031). This report summarises a first-pass risk assessment which will be used as a foundation for a detailed risk assessment and subsequent climate change adaptation plan. This first-pass risk assessment is a qualitative identification of risks and builds from the Ministry for the Environment's *Guidance for Local Climate Risk Assessment*. It will enable a comprehensive risk assessment to inform adaptation planning, asset management, and strategic long-term planning within the district.

The key objectives of this first-pass risk assessment were to:

1. Identify the climate-influenced hazards and scenarios that need to be developed to comprehensively understand the Buller district's risk profile.
2. Identify potential risks and opportunities for the Buller District as a result of climate change.
3. Identify elements (assets, taonga, people, and places) that serve as indicators of these risks in the Buller District.

These objectives were achieved through a series of workshops with stakeholders familiar with the Buller District. Risks have been categorised into wellbeing domains modified from the National Climate Change Risk Assessment: Human, Built, Natural, Kaupapa Māori, Economic, and Governance (see table below). The knowledge from these workshops will ensure that the risk assessment focuses on what is important to the Buller community, informed by the views, values, and perceptions of the stakeholders in attendance. There will be regular opportunities to engage and refine this focus throughout the project.

Potential risks for the Buller District identified by workshop attendees

PĀPORI | HUMAN	BUILT ENVIRONMENT | TAIAO HANGA	NATURAL ENVIRONMENT | TE TAIAO
Risk to: • social cohesion and community wellbeing (incl. mental health) • physical health from exposure to hazards • exacerbating and creating inequalities • heritage and culturally significant sites • accessing medical care and emergency services • accessing education • accessing community services • accessing food/resources • recreation • communications • homes and personal assets	**Risk to:** • potable water supply • buildings (residential, commercial, industrial, and other structures) • landfills and contaminated sites • wastewater and stormwater • transportation • electricity, energy and communications	**Risk to:** • indigenous terrestrial ecosystems and organisms • indigenous marine ecosystems and organisms • indigenous freshwater ecosystems and organisms • exotic ecosystems and species • parks and blue-green infrastructure • endangered species • natural structures, formations, and/or regimes (e.g. river channels) • use of natural sites/recreation sites • mahinga kai and cultural resources

Potential risks for the Buller District identified by workshop attendees (cont.)

KAUPAPA MĀORI	ECONOMIC | OHAOHA	GOVERNANCE | MANA WHAKAHAERE
Risk to: • Māori social and cultural wellbeing • waiora - wellbeing/health • Māori cultural sites • mahinga kai species and collection • locality of Tangata Whenua • mauri, wairua and adaptive capacity • Māori/Tangata Whenua autonomy/Te Tiriti rights	**Risk of/to:** • insufficient local government income/excess expenditure • overall financial system (e.g. banks) instability • land-based primary sector viability • tourism sector viability • fisheries sector viability • the insurability of assets • productivity due to supply chain and distribution system disruptions • exacerbating economic inequality • mineral sector • new industries (in particular technology)	**Risk of:** • maladaptation due to processes not accounting for uncertainty and long-term change • climate adaptation not supported by institutions, processes, funding mechanisms • increased litigation • breaching Treaty obligations • maladaptation due to knowledge and capacity gaps • EM system not adequately responding • doing nothing as elected members cannot agree or are not engaged in climate-hazard challenges • failure to follow democratic process due to frequency and scale of impacts • path dependency / sunk cost fallacy • loss of community trust and buy-in

1. Introduction | Whakataki

Climate change presents both risks and opportunities to the Buller District. The present-day impacts of a changing climate and hazardscape are already being noticed within the built and natural environments, and the cascading impacts are being felt in the communities, businesses, and institutions. As the climate continues to change, these impacts will likely be exacerbated. Understanding, with a view to managing and taking advantage of these challenges and opportunities is the objective of a risk assessment and adaptation programme.

Extreme weather is one of the most salient consequences of climate change and has already been experienced in the Buller District. The extreme flood events of July 2021 and February 2022 – estimated by the Buller District Council to cost >100m NZD and 20-45m NZD, respectively – are indications of what a changing climate will bring. Based on current warming alone, climate scientists estimate that at least 30% of recent worldwide weather-related economic losses are attributable to climate change (Frame et al., 2020).

Another threat from climate change is sea level rise. While all of New Zealand is exposed to coastal hazards, the Buller District has one of the highest levels of exposure. Figure 1 shows coastal flood risk based on today's sea level and this is based on coastal flooding alone (excluding planned defensive infrastructure). In addition to threats from the flood waters, these and other at-risk areas may be subject to insurance retreat or rising premiums. As these risks, among others, increase with climate change, the district must begin to adapt.

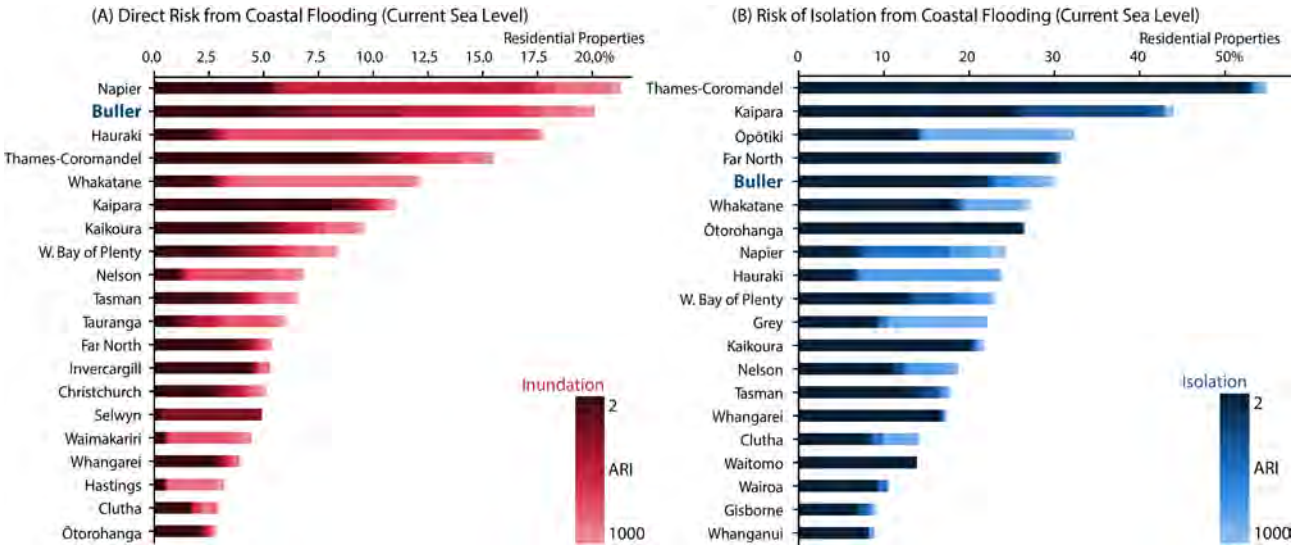


Figure 1: Current coastal flood risk (based on percentage of residential properties affected) in the twenty most exposed territorial authorities in New Zealand. This shows the risk from coastal flooding with annual return intervals (ARIs) between 2-1000 years for current sea level. (A) Inundation occurs when a building is exposed at any depth. (B) Isolation occurs when the roads are flooded such that cars cannot pass. Although this may be temporary isolation, long-term road damage is possible, risking extended isolation. (Source: Logan et al. 2022 based on coastal flood maps from NIWA (2021)).

However, climate change comes with more than physical risks and exacerbated natural hazards: the transition towards a low-carbon economy brings risks of its own. These are known as transition risks and include things like stricter environmental regulations, increased transportation costs and indirect price increases, carbon taxes, and cascading impacts from disruptions elsewhere. A key transition risk for the Buller District is the loss of the coal mining sector. Similarly, there are major opportunities from this transition including for new technology and improved reputation. Risks from climate change therefore are commonly categorised into transition or physical risks and this relationship is shown in Figure 2.

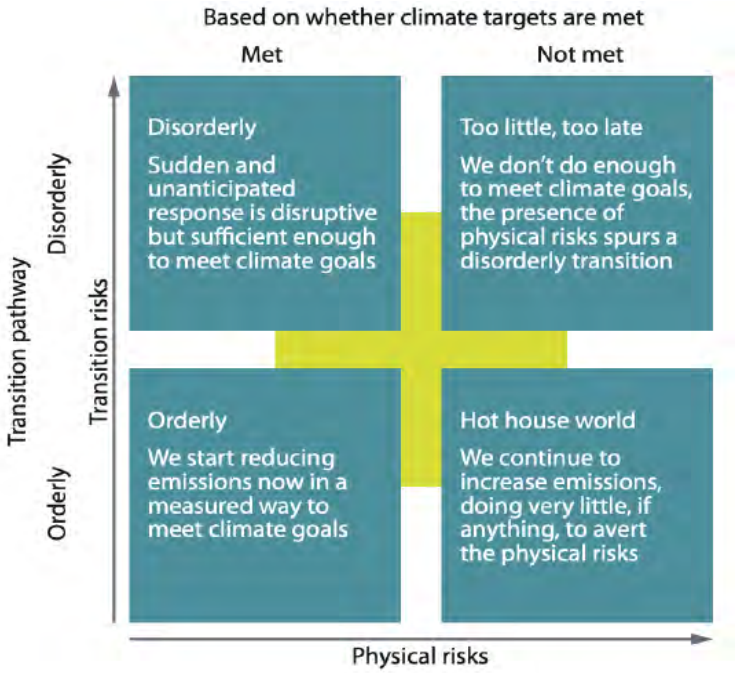


Figure 2: Climate change brings with it physical and transition risks. These are the climate scenarios adopted for New Zealand climate risk reporting with a description of how they can lead to transition and physical risks (NGFS, 2019).

Cognisant of these risks, the Buller District Council has committed to Climate Change Adaptation as part of its Long-term Plan (2021-2031). The LTP 2021 – 2031 adopts the following approaches or principles, which will guide the adaptation planning process:

1. Use science to build scenarios for communities across the district to identify the key climate change related impacts, the likelihood of these occurring, and issue-specific response options
2. Partner with central government, including the Ministry for the Environment, the West Coast Regional Council, and scientific agencies to secure the necessary support for the adaptation planning process
3. Collaborate with the West Coast Regional Council and communities to identify the district's significant social, cultural, and economic values that are under threat
4. Use the adaptation planning process to inform Council's future policies and strategies and Te Tai o Poutini Plan.

As with all of Council's strategic projects, a partnership approach with Ngāti Waewae will be used to ensure cultural considerations, including Te Ao Māori and Mātauranga Māori, are incorporated at every stage of the planning process.

An impact consideration for the adaptation process and further highlighting the importance of proactive planning is the district's socioeconomic profile. At the time of the 2018 census, there were almost 10,000 people living within the district. The median income was $22,900 compared to $31,800 nationally. Almost 25% of the population were older than 65 and less than 13% were aged between 15 and 29. Understanding the needs and vulnerabilities of the community is an important part of the adaptation process.

This report presents the findings of the 'first-pass' risk assessment, which is the third stage of Buller's Climate Adaptation Programme and is the first step to understanding and managing physical climate risks. This is a key step in the overall project to assess climate change risk for the district and develop adaptation plans as detailed in Figure 3.

The key objectives of this first-pass risk assessment are to:

1. Identify the climate-influenced hazards and scenarios that need to be developed to comprehensively understand the Buller District's risk profile (Stage 4).
2. Identify potential risks and opportunities for the Buller District as a result of climate change.
3. Identify elements (assets, taonga, people, and places) that serve as indicators of these risks in the Buller District.

Note that this risk identification is largely limited to physical risks. Transition risks will be considered in later stages of the programme.

The outputs of this first pass are enablers for a hazard assessment (Stage 4) and comprehensive risk analysis and prioritisation (Stage 5 and 6). The comprehensive risk analysis will then be used to inform climate adaptation planning (Stage 7) and wider risk-informed asset management and strategic land-use planning. Ultimately, this process will prepare the district for the changes, enabling the community to become more resilient, sustainable, and well-positioned to take advantage of opportunities that will arise from the transition.

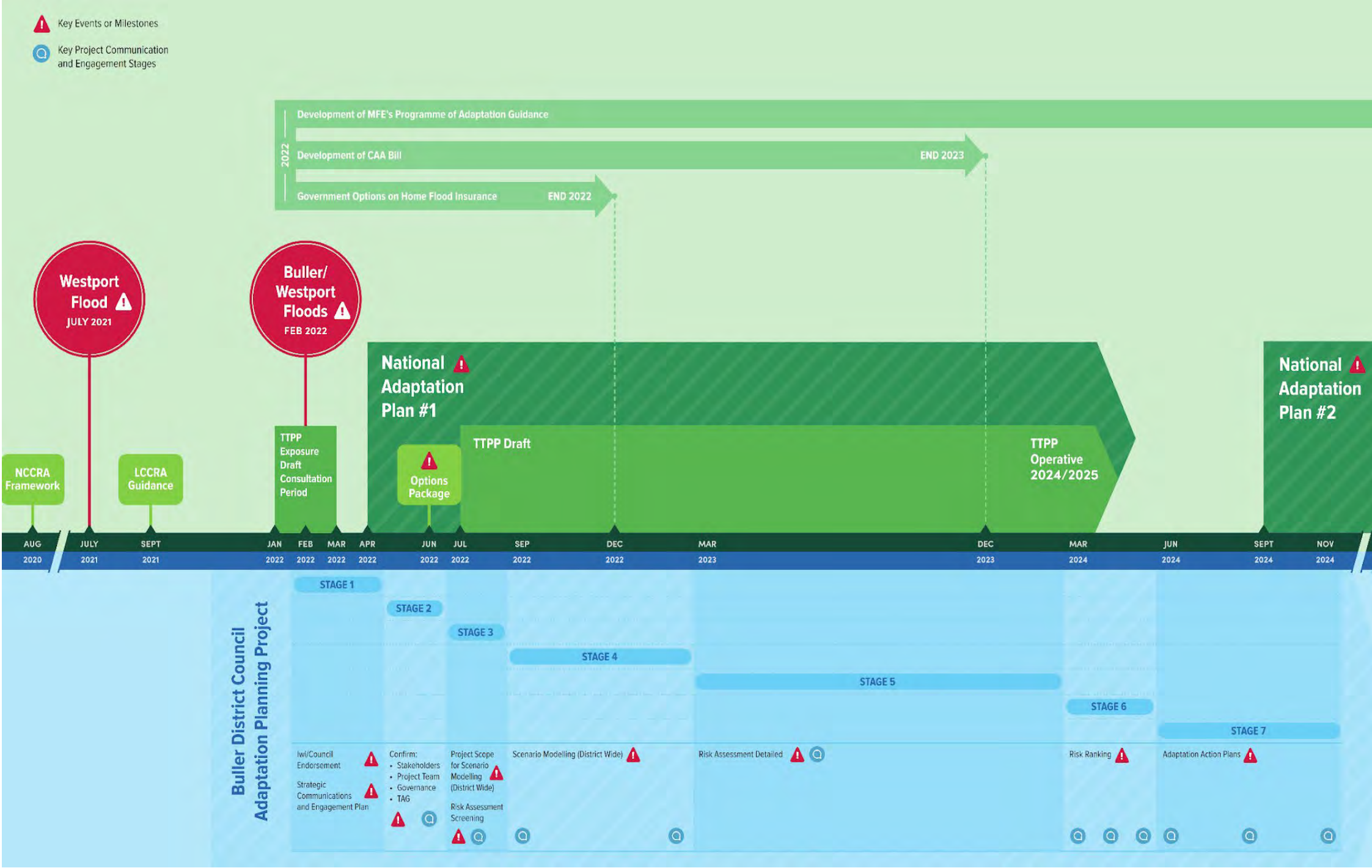


Figure 3: Stages of the Buller District's Climate Adaptation Planning Programme.

Climate risk is uniquely complicated because uncertainty is so inherent, the consequences are highly interdependent across societal domains, and both the uncertainty and consequence vary over time and space. To address this and avoid path dependencies, the comprehensive risk assessment will evaluate consequences and uncertainty over a range of climate scenarios and timeframes, enabling adaptive decision making. It will also consider the risk to six societal wellbeing domains (built, natural, human, Kaupapa Māori economic, and governance), so that adaptive actions can be evaluated for co-benefits and trade-offs.

The overarching objective is to enable climate resilient decisions and development for the benefit of the whole district. Climate resilient development, and the risk from climate change, is the result of cumulative societal choices and actions in multiple areas, Figure 4 (Pörtner et al., 2022). Embedding risk-informed and adaptive decision making throughout Council processes are therefore essential for tackling system-wide challenges like climate change.

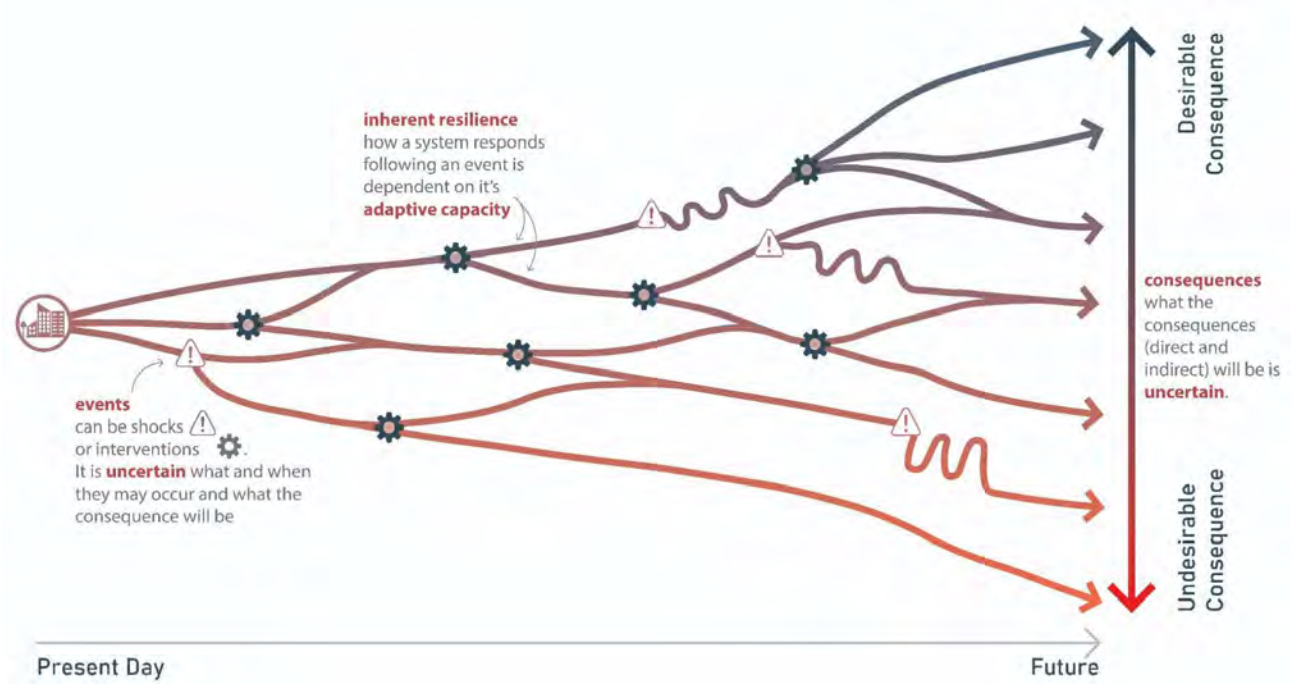


Figure 4: Climate change risk is changing over time and is the product of cumulative societal decisions and other events that lead to consequences (positive and negative). Source: Logan et al. (2022).

This system-wide complexity and interconnectedness of climate risk makes a first-pass assessment necessary. The first-pass assessment provides a qualitative understanding of the local values, related elements, hazards, and dependencies that need to be considered within the subsequent comprehensive assessment of risk. This is consistent with the ISO31000 guidance for risk assessment and the National Climate Change Risk Assessment and the Ministry for the Environment's Guidance for Local Climate Risk Assessment (Ministry for the Environment, 2020, 2021).

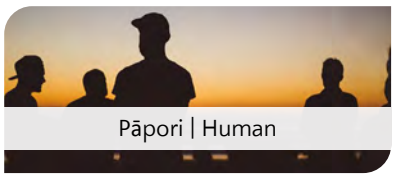
2. First-pass risk assessment framework and approach | Nga aromatawai mōrearea

2.1 Framework and risk domains

To adapt to climate change, it is necessary to understand what could be affected and how it might be affected. That is, we need to understand the risk. The most general definition of risk is the consequences (positive and negative) of an activity and associated uncertainties (SRA, 2015). Therefore, to understand risk, it is important to evaluate the consequences arising from potential future climate scenarios.

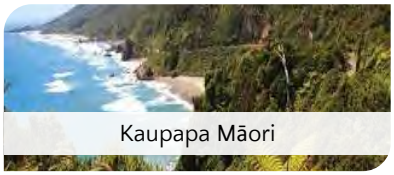
RISK:
The outcomes (positive and negative) of an activity and associated uncertainties.

Consequences are considered in terms of what people value. Therefore, the first step, and the objective of this first-pass assessment, is to identify the **elements** (assets, taonga, people, places) that should be considered in the risk assessment. We evaluate the potential risk to six wellbeing **domains**, modified from the National Climate Change Risk Assessment, Treasury's Living Standards Framework, and He huringa āhuarangi, he huringa ao (Awatere et al., 2021; Ministry for the Environment, 2020; The Treasury, 2021): the Human, Built environment, Natural environment, Kaupapa Māori, Economic, and Governance domains.


Pāpori | Human


Taiao Hanga | Built environment


Te Taiao | Natural environment


Kaupapa Māori

Ohaoha | Economic


Mana Whakahaere | Governance

The Kaupapa Māori domain was proposed, in recognition of the partnership with Tangata Whenua, in order to specifically consider and identify concerns of and opportunities for Māori. These risks also appear in the other value domains due to their interconnected nature.

Risk categories within each of these value domains are referred to as **subdomains**. For example, "Risk to transportation" is a subdomain of the Built Environment domain. Risk to transportation arises due to risk to relevant elements such as roading and community isolation. Through the workshops, these six value domains, subdomain risks, and relevant elements were tested and further developed with local stakeholders and technical specialists.

Consequences will be rigorously assessed through the detailed risk assessment in Stage 5 of Buller's Climate Adaptation Programme. This will include, for all elements to all **hazards**, an analysis of **exposure**, **vulnerability**, and **criticality**. Due to the uncertainty inherent in climatic change and impacts, these consequences will be assessed under different climate conditions (scenarios), enabling adaptive management. Additionally, in the detailed assessment, the strength of the underlying evidence will be assessed to provide further nuance to decision-makers.

2.2 Approach to engagement

Consequences are a key aspect of climate risk and these are considered in terms of what the community values. A bottom-up approach has been used to identify and define these values.

A series of engagement activities, including hui, korero and awheawhe (gatherings, discussions and workshops), were undertaken with key community stakeholders and subject experts. Engagement focused on whakawhanaungatanga (the process of building relationships) to create reciprocal relationships, which foster a long-term connection between stakeholders. These engagement activities were structured around the domains identified in Section 2.1 and provide a 'first-pass,' high-level identification of community values, climate-influenced hazards, and potentially 'at-risk' elements.

A range of stakeholders were engaged in these activities from the following organisations:

- Buller District Council
- Ngāti Waewae
- Buller Electricity Limited
- Waka Kotahi
- National Emergency Management Agency
- Aged Concern
- Flood Recovery Navigator Service
- Home Builders
- West Coast District Health Board
- Department of Conservation
- The Nature Conservancy
- Bathurst Resources Limited
- Development West Coast
- Department of Internal Affairs
- Ministry of Business, Innovation and Employment
- KiwiRail
- Chorus
- New Zealand Lifelines

A full list of attending and invited stakeholders can be found in Appendix A.

Stakeholders clearly recognised the enormous impact that climate change may have on the Buller District. Appendix B illustrates the array of impacts as recognised by workshop participants over the next 50 years.

Hui and korero with local hapū are essential for representing Tangata Whenua and enabling valuable reciprocal and holistic discussions which benefit all parties. It is important to note that Te Tiriti o Waitangi values are upheld by these korero, relationships are also founded, and people are empowered through mutual connections. A further engagement with Ngāti Waewae, Mana Whenua of the district, is currently in the planning phase which will enable the next stages of this programme to:

- Identify and understanding local Tikanga Māori.
- Understand the interconnectivity of Te Āo Māori.
- Identify significant local taonga (treasures).
- Understand how Mātauranga Māori, Te Āo Māori, and Tikanga Māori can be represented by a CCRA.

3. Summary of climate change and climate-influenced hazards for the Buller District | Nga hua o te huringa o te rangi ki Kawatiri

3.1 Climate Change

While climate change is often seen as a distant or future problem, New Zealand and the Buller District are already experiencing the effects. Notably, global annual temperatures have increased by over 1°C in the last century, oceans have risen by 19cm (between 1901-2010), and the frequency and intensity of storms have increased (Ministry for the Environment, 2020). These changes in our climate pose risks to our communities, values and way of life.

Anthropogenic greenhouse gas (GHG) emissions are driving global climate change. This trend is due to Earth receiving more incoming energy from the sun than it radiates back into space, known as climate forcing, due to GHGs insulating the atmosphere. This results in a net gain of energy, which in turn causes warming and risks a series of cascading consequences.

Continued emissions of GHGs will cause further warming and future emissions are highly uncertain. To reflect this uncertainty, the Intergovernmental Panel on Climate Change (IPCC) defined five Shared Socioeconomic Pathways (SSPs) for a range of GHG emission scenarios and predicted climate forcings (Pörtner et al., 2022). These SSPs replace the formerly used Representative Concentration Pathways (RCPs) by capturing socioeconomic drivers and potential emission reduction scenarios. These SSPs provide modelled trajectories for a range of emission scenarios, ranging from SSP1 (the sustainable approach), a 'dramatic emissions reduction scenario' to SSP5 (fossil-fuelled development), a 'steady increase in emission scenario'. Each scenario is correlated to a radiative/climate forcing or change in energy flux in the atmosphere: SSP1-**1.9**, SSP1-**2.6**, SSP2-**4.5**, SSP3-**7.0** and SSP5-**8.5**. For example, Figure 5 shows predicted carbon dioxide emissions for the various scenarios until the end of the century (2100). This uncertainty in the future climate means that communities around the world must embrace adaptive and risk-informed planning if they are to avoid ineffective or detrimental action.

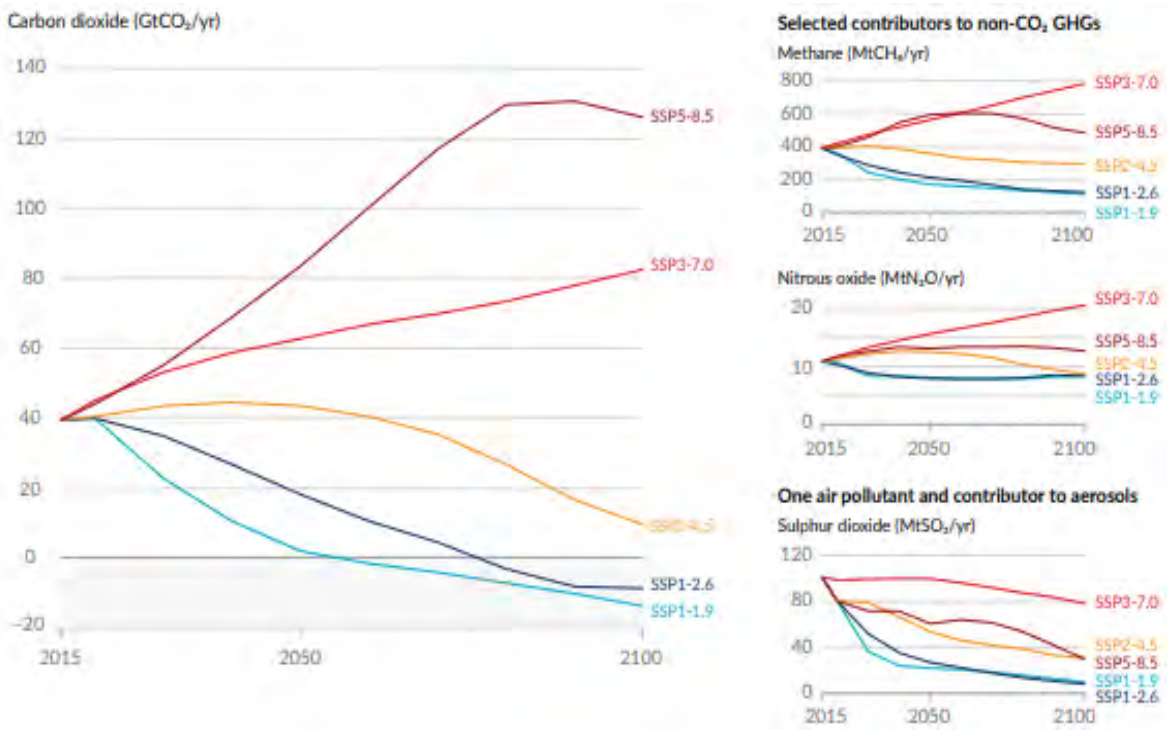


Figure 5: Future annual emissions of CO_2 (left) and of a subset of key non-CO_2 drivers (right), across five illustrative emission scenarios (SSPs) (Masson-Delmotte et al., 2021).

In New Zealand, the average annual temperature increased by 1.1°C between 1910 and 2020 and scenarios forecast by the IPCC range from a further 0.1°C to 4.6°C warming by 2090-2100. According to New Zealand climate researchers, the most likely scenario for New Zealand is an increase between 0.7-3.0°C (Bodeker et al., 2022; Hennessy et al., 2022; Pörtner et al., 2022). Figure 6 shows the predicted range of global temperature variability since 1950, demonstrating a positive trend that is expected to continue under both the SSP2 and SSP5 scenarios until at least the turn of the century. These rising temperatures exacerbate storm intensity, heat waves, rising sea levels, rainfall extremes, melting glaciers and warming oceans.

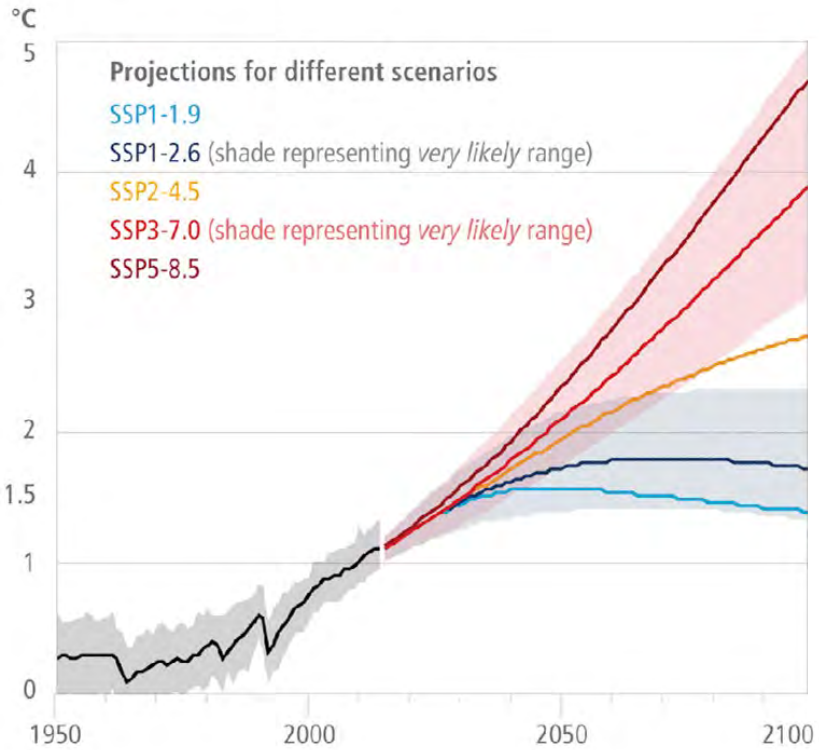


Figure 6: Global surface temperature change (relative to 1850-1900) for different emission scenarios (SSPs) (Pörtner et al., 2022).

3.2 Climate-Influenced Hazards

Sea level rise

Sea level rise (SLR) is the relative increase in sea level due to both climate change and vertical land movement (VLM). Warming global temperatures are the primary driver of sea level rise. As temperatures increase, terrestrial ice melts and thermal expansion of the ocean occurs.

Sea level rise in the Buller District

Buller District has a long coastline; therefore, Buller is highly exposed to SLR. The rate and extent of SLR at a local level is highly uncertain, compounded further by uncertainty in VLM. By 2100 Westport could experience between 0.5m and 1.2m of sea level rise, under SSP2-4.5 and SSP5-8.5, respectively, Figure 7 (NZ SeaRise Maps, 2022).

Impacts of sea level rise

While sea level rise alone has the potential to have substantial consequences on coastal areas, it exacerbates other hazards, including extreme weather events, coastal flooding, and coastal erosion.

SLR is expected to increase the frequency of equivalent impact events. For example, 30cm of SLR in Auckland will result in current day 1 in 100-year high water events occurring once in every 4 years; In Christchurch and Wellington the 1 in 100-year current day equivalent event is expected to occur every year at 30cm of SLR (Lawrence et al., 2021). It can be expected that the Buller District will also experience increases.

Data currently available for the Buller District

NZ SeaRise has data for predicted sea level rise and vertical land movement at 2 km intervals around the coast. The sea-level rise predictions are based on SSP's 1-1.9, 1-2.6, 2-4.5, 3-7.0, and, 5-8.5 (NZ SeaRise Maps, 2022).

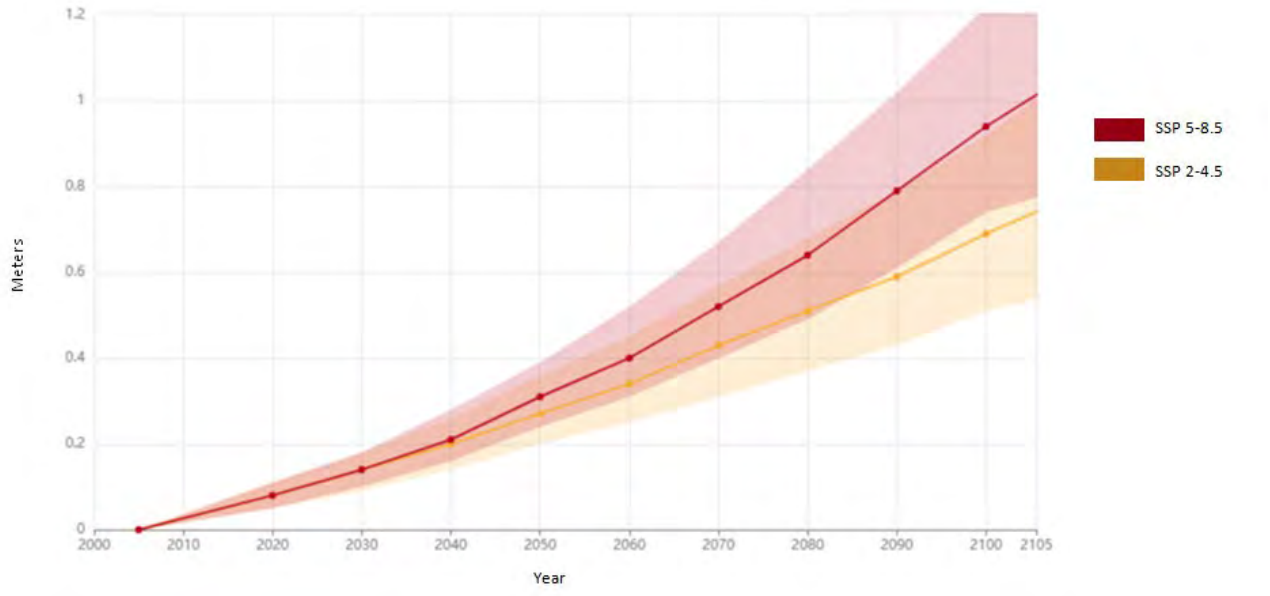


Figure 7: SLR projections including vertical land movement in Westport (NZ SeaRise Maps, 2022).

Coastal flooding

Coastal flooding is the inundation of coastal land by sea water. This can occur due to perigean spring tides (king tides), coastal storm surges, or wave set up (the rising of the mean sea-level in the surf zone). Coastal flooding becomes even more likely when these events occur simultaneously. Sea level rise exacerbates coastal flooding by increasing the baseline sea level (NIWA, n.d).

Coastal flooding in the Buller District

Coastal flooding will be exacerbated due to rising sea levels increasing frequency and intensity.

Sea levels are predicted to increase by 0.3-1.2m by 2100 (various SSP scenarios) as well as storm surges by 1-5% (Bell et al., 2016; Kopp et al., 2014; Pörtner et al., 2022).

Impacts of coastal flooding

There is the potential for a significant proportion of the coastal area and population of the region to be impacted due to the proximity of assets to the coastline (Figure 8).

The percentage of properties in the Buller District exposed to a coastal flood is expected to increase from ≈ 10% to 15-25% by 2060 and 20-30% by 2100 (Figure 8). Properties that are not directly exposed may experience isolation. The percentage of properties that may be isolated due to flooding and road damage could be as high as 60% by 2120. Coastal flooding has wide cascading impacts for communities, tourism, and the district's economy.

Coastal flooding can cause large erosion events where meters of coastline can be lost. Coastal roads may be closed or become hazardous during these events. Stormwater and drainage networks may become overwhelmed.

Pastures damage can occur due to salt burn. This has a prolonged effect taking up to a year for pasture to recover. Reducing the capacity for land to be used productively.

Data currently available for the Buller District

The West Coast Regional Council (WCRC) commissioned coastal inundation modelling for 20cm increments of SLR up to 2m and an ARI 100 storm event. The Te Tai o Poutini Plan (TTPP) includes this data in the form of "Coastal Alert" and "Coastal Severe" overlays indicative of the severity of threat to different areas. The TTPP also has "Coastal Setback" overlay showing areas that may be at risk but modelling has not been undertaken. These maps will be updated when the updated LIDAR becomes available.

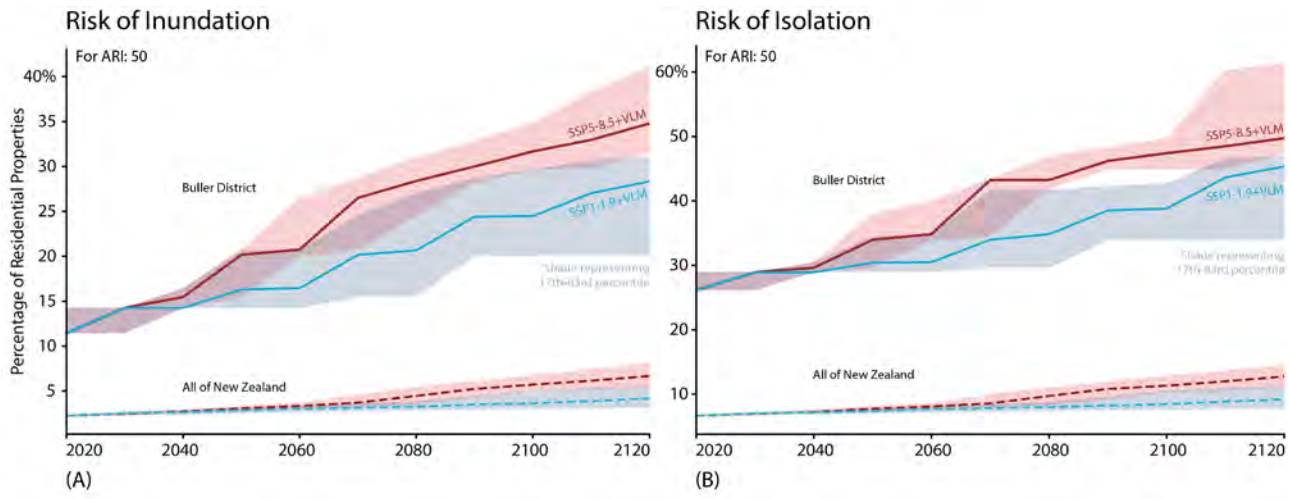


Figure 8: The percentage of residents at risk from inundation and isolation as a result of coastal flooding and how this risk changes over time under different emission scenarios. Risk of inundation refers to the potential of a property being flooded. Risk of isolation is the potential for the property to be cut-off due to flooding on roads, making them impassable. This could lead to longer-term damage and isolation. These results do not include any planned defensive infrastructure and only include coastal flooding. (Source: Logan et al. 2022 based on coastal flood maps from NIWA (2021)).

Coastal erosion

Coastal erosion is the loss of land along a coastal area. Coastal erosion takes on many forms, including beach erosion, erosion of beach barriers (including dunes), river mouth migration, and river mouth extension. Key drivers of coastal erosion include wave-action, tides, currents, wind-driven water, sea level rise, and other impacts of storms.

Coastal erosion in the Buller District

The effects of coastal erosion can be witnessed in areas along Buller's coastline already (Figure 9), however, climate change will increase the rate and extent of coastal erosion (Ministry for the Environment 2001, Ministry for the Environment, 2020).

Erosive patterns along Buller's coastline will significantly increase with rising sea levels and intensified storm surges (Ministry for the Environment, 2020; Rouse et al., 2017).

The severity and timescale of coastal erosion in the Buller District are relatively unknown, however, it is predicted that in Australasia erosion rates may increase by up to 60% (Lawrence et al., 2021).

Impacts of coastal erosion

With a significant proportion of the Buller District's assets located along its 150km of coastline, coastal erosion poses a significant threat to a wide range of assets.

Many of Buller's communities are located on or near the coast. As the sea encroaches these communities are at risk from damage, isolation, insurance retreat, and property value loss.

A significant length of SH6 runs along the coast. It is highly exposed to coastal erosion and may be prone to washouts and closures.

Erosion rate and scale can alter coastal cycles of accretion and erosion, coastal sediment down-drift. This has ramification for ecological environments.

Data currently available for the Buller District

The TTPP has a "Coastal Severe" overlay that includes modelled risk from erosion. NIWA has investigated 13 coastal hazard areas and their potential for erosion (Measures & Rouse 2012). These are also currently being updated.

Figure 9: Coastal erosion at Carters Beach in 2003 (left) and 2019 (right) (Google Earth Pro 2003 and 2019).

Tsunami

Tsunamis are a series of extremely long waves that gather height/amplitude as they move into shallower and shallower water. The cause of a tsunami is often a large and sudden displacement of water in the ocean or a lake, usually resulting from an earthquake or volcanic eruption below or near the ocean/lake floor. These are exacerbated by high sea levels.

Tsunami in the Buller District

Buller District's position on the western coast of the South Island shields it from far-field tsunami, thus the risk from these types of tsunamis is low (Buller District Council., 2006). Tsunamis due to local events are possible, as seen during the 1913 Westport earthquake which resulted in a 1.5m high wave (Buller District Council., 2006)

The intensity of tsunamis is predicted to increase with sea level rise. With 0.5m of sea level rise, tsunami intensity may increase by up to 50% (Li et al., 2018). However, the direct implication of tsunami risk with sea level rise in the Buller District are undescribed at this time.

A significant tsunami in Buller is unlikely to occur due to an alpine fault rupture (Orchiston et al., 2016). Localised tsunami events may occur as a result of offshore aftershocks.

Impacts of tsunami

A large proportion of the Buller District's population and assets are located in low lying coastal areas and therefore exposed to tsunami hazard, a risk that will increase with rising sea levels.

Modelling of a tsunami event in Karamea suggests that the airport north of Karamea, state highway 67 between Karamea and Little Wanganui substation, and the substation at Kongahu is likely to be inundated. This will impact access to the town and electricity supply to the district.

Modelling for Westport shows significant damage to the boat harbour at the north end of the town is expected. The airport is also expected to experience inundation and damage to the runway.

Data currently available for the Buller District

1-in-500 year tsunami events were modelled for some areas in Buller (Westport and Karamea) but these models excluded effect of SLR on tsunami risk (West Coast Civil Defence Emergency Management Group, 2017). NEMA has also released tsunami evacuation maps (Figure 10) (NEMA n.d.), these maps are based on GNS modelling (Gusman et al. 2020, Leonard et al. 2015). A "Coastal Tsunami" overlay is also available in the TTPP.

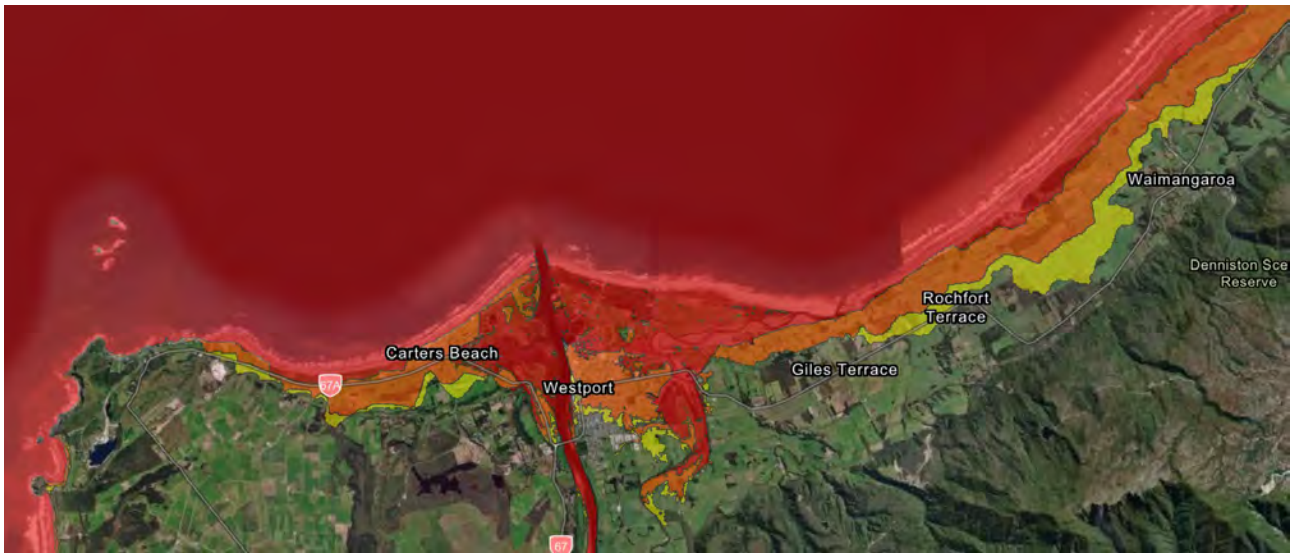


Figure 10: Tsunami evacuation zones (NEMA n.d.).

Groundwater

Groundwater levels and salinity may change due to sea level rise or changes in precipitation in the upper catchment.

Groundwater in the Buller District

Ground water levels can vary due to precipitation, human influences (e.g. ground water extraction), and atmospheric pressure. Sea level rise will also raise coastal water tables (Kumar, 2012).

Impacts of groundwater

High groundwater levels increase the fluvial and pluvial flood risk, reduces agricultural productivity, and exacerbates other hazards.

Shallower ground water can increase the chance of liquefaction during earthquake events.

Increased sea levels may increase groundwater salinity, affecting plants and ecosystems. Salinisation and other types of contamination due to changes in groundwater conditions may impact aquifers Contaminants can rapidly spread within aquifers, making them unsafe to drink without further treatment and negatively impacting those that rely on boreholes for their drinking water.

Higher and more saline groundwater will damage and increase the deterioration rate of buried infrastructure.

Data currently available for the Buller District

Currently, there is no information or analysis to our knowledge about the potential groundwater change and its consequences in the Buller District.

Pluvial (surface water) flooding

Pluvial flooding incorporates two types of flooding: flash flooding and surface water flooding (not river flooding, which is known as fluvial flooding). Pluvial flooding occurs when the inflow of water, generally through intense rain, exceeds the capacity of the ground and/or infrastructure to drain away the water.

Pluvial flooding in the Buller District

Climate change is expected to alter the spatial, temporal and intensity trends of rainfall. During summer and autumn, rainfall in 2090 is expected to remain within 2-5% of 1995 values, but with significant uncertainty (Mullan et al., 2018). Winter rainfall on the West Coast is predicted to increase by 8%-29% by 2090, also relative to 1995 (Ministry for the Environment. 2018).

The combination of increased rainfall intensity and magnitude, rising sea levels and rising water tables are expected to exacerbate the pluvial flood risk in the Buller District (Manning et al., 2015, Zhou et al., 2012).

Impacts of pluvial flooding

Pluvial flooding in the Buller District poses a significant risk to human values and the built environment. If storm water infrastructure becomes overwhelmed due to the large amounts of water, there could be severe impacts for communities.

The direct impacts of flooding can include loss of life, infrastructure, crops, and livestock. This can be devastating to communities as their resources and livelihoods have been destroyed.

Infrastructure like roads can be damaged or flooded reducing the access for emergency services in the short term and tourists and supply lines in the long term.

Data currently available for the Buller District

NIWA has modelled how rainfall will change across the country, but there is no pluvial flood modelling currently available for Buller to our knowledge.

Fluvial (river) flooding

Fluvial flooding is when the amount of water exceeds the capacity of the river. Rainfall in the river's catchment is the primary driver of river flooding in the Buller District. Confinement or alterations of river systems can exacerbate or reduce the extent of a flood.

Fluvial flooding in the Buller District

Fluvial flooding is a substantial risk in the Buller District due to high annual rainfall and main centres constructed around waterways and on natural floodplains.

Similarly, to pluvial flooding, fluvial flood risk is expected to increase in the Buller region. Under an RCP 8.5 (2056-2099) one quarter of people in flood hazard areas on the West Coast can expect a more than 20% increase in mean annual floods, which is higher than any other region (Paulik, Craig, et al., 2019). The flood hazard areas for this study used historic flood and soil profiles to find at-risk areas.

Impacts of fluvial flooding

Fluvial flooding can cause significant damage to infrastructure, the natural environment and humans, as the flow of water can be extremely powerful.

The impacts of fluvial flooding and pluvial flooding are similar, both disrupt access and the local economy as well as potentially damaging property or lead to the loss of life.

Data currently available for the Buller District

The TTPP includes flood modelling for most rivers in the District, with threatened areas categorised as "Flood Severe" and "Flood Susceptibility". These are based on sea-level rise increments of 0, 0.7, and 1m as well as rainfall events with an annual return interval of 50 and 100 years (current day and A1B climate scenarios).

Land slips, debris flows, and falls

Slips, debris flows and falls are mass erosion events, where there is a rapid movement of material. Generally, these occur during rain events but can also occur as a result of earthquakes or undercutting by a river.

Land slips, debris flows, and falls in the Buller District

In the Buller District, climate change is likely to significantly impact erosive processes. Buller's soil is predominantly formed with highly erodible sedimentary material, comprised of podzol and brown soils, with intrusive basement rocks inland (Hewitt, 2010; Rattenbury and Isaac, 2012).

Overall, rainfall intensity on the West Coast is predicted to become more variable, with up to a 29% increase in winter rainfall by the end of the century (Ministry for the Environment. 2018). Higher rainfall intensity and peak river flows also increase erosion, nutrient loads and sediment in waterways, which drives further erosion (Lawrence et al., 2021).

Impacts of land slips, debris flows, and falls

Erosion is predicted to have significant consequences on intense agricultural and sloping land. Erosive processes threaten both coastal and inland environments in the Buller region, with higher potential risk with increasing slope angle. Currently, there is significant risk associated with erosion events, however, changes in precipitation will only increase this.

These mass erosion events can directly impact people and infrastructure removing the material below them, or depositing material on top of them.

Indirect impacts can include landslide damns that impede waterflows to towns or that can burst and send a large amount of water and debris into the flood plains below.

Data currently available for the Buller District

The TTPP has a "Land instability" overlay that identifies land that based on modelling may be susceptible to landslide, debris flow and rockfall. A land slide susceptibility map has also been created for the West Coast Region that has 5 levels of susceptibility and 25 m definition (England, 2022). Changing rainfall patterns are expected to increase the risk from landslides, but no modelling on this has been completed to date.

Extreme wind

Extreme wind events can occur with frontal weather systems, around strong convective storms such as thunderstorms, and ex-tropical cyclones.

Extreme wind in the Buller District

The extreme wind speed in the South Island is expected to increase by up to 10% by 2090 (RCP 8.5) (Lawrence et al., 2021). The frequency of extreme wind events is also expected to increase by 2-5% (Ministry for the Environment. 2018).

Westerly winds will continue to dominate and will likely increase in frequency, especially in winter and spring. Mid-latitude cyclones and other storms are expected to shift poleward, with the potential for a slight reduction in prevalence (Lawrence et al., 2021).

Impacts of extreme wind

While steady wind can be an important resource, strong gusts can damage property, topple trees, and disrupt transportation, communications, and electricity. Changes in extreme wind prevalence and severity may result in significant direct or cascading indirect risk. Extreme winds are often associated with ex-tropical cyclones and frontal weather events, so may have significant capacity to damage infrastructure and exacerbate erosion.

Increased extremely windy days will exacerbate orographic (moist air being forced to rise due to mountains) rainfall related hazards and erosion throughout most of the district. Overall, the direct and indirect implications of climate change driven extreme wind aggravation will be heightened with increasing climate change severity.

Data currently available for the Buller District

NIWA has modelled change in extreme daily wind speed by 2100, but no District specific information is available to our knowledge.

Rising temperatures

The greenhouse effect from carbon dioxide and methane has led to a rise in global average temperatures.

Rising temperatures in the Buller District

The average temperature of the West Coast is expected to increase due to climate change. Up to 1.0˚C of warming is expected by 2040 and as much as 3.0˚C of warming could occur by 2090 (Ministry for the Environment. 2018). Most of this warming will be experienced in summer and autumn (Ministry for the Environment. 2018).

Impacts of rising temperatures

Rising temperatures have geophysical flow on effects, including sea level rise and increased storm frequency and severity. A rise in temperature also will increase the risk from invasive species and vector-borne illnesses, threatening our communities and ecosystems.

Even a subtle change in average temperature can have far-reaching impacts. Ecosystems will change as species migrate to areas that have a more habitable climate. Conditions may become more suitable for invasive species which could adversely affect agriculture, horticulture, and indigenous ecosystems. This increase in temperature could, in some cases, also lead to opportunities for primary production.

Data currently available for the Buller District

A nationwide map of expected temperature rise is available at a 5km resolution for four RCPs until 2100. This data is also available for Westport as a time series for these four RCPS until 2100 (NIWA 2016).

Extreme temperature

Extreme temperatures are typically referring to temperature variations above (extreme heat) normal conditions (Zlatanova, 2014). In the Buller District, climate change is likely to influence local temperatures due to the global warming effect. Warmer temperatures globally will see the emergence of more extreme weather events in New Zealand and the Buller District.

Extreme temperature in the Buller District

By 2090 the West Coast is predicted annually to experience up to 30 more extreme heat days (temperature > 25°C) and 7-18 fewer frost days per year (Ministry for the Environment, 2018). More extreme levels of global temperature rise will result in greater variability and occurrence of local temperatures and temperature extremes (Lawrence et al., 2021).

Changes in albedo (incoming radiation reflected) with changing land cover will significantly influence the prevalence of extreme temperature days.

Impacts of extreme temperatures

While higher temperatures for the Buller District may not pose the risks to life seen in other locations, there are still significant secondary effects such as impacts on productive land-use, native ecosystems, recreational and cultural values. These impacts can have sizable economic, environmental, and social ramifications.

Data currently available for the Buller District

There is data showing the expected number of extreme temperature days (>25 °C) can be found spatial disturbed on a national map with good resolution as well as a time series for Westport (NIWA 2016).

Drought

A drought is when an area or region experiences a relative deficit of rainfall. Droughts are the result of a lack of precipitation or high evaporation (often during summer months), which results in a soil moisture deficit. Although Buller has significant rainfall annually, slight changes in rainfall, wind, or land-use conditions due to climate change could result in relative drought or dry periods in the future.

Drought in the Buller District

The West Coast overall is not likely to see a significant increase in drought conditions. However, the Buller region is exposed to some climate change-driven drought risk, with Cape Foulwind and inland areas (e.g. Springs Junction) potentially experiencing up to a 5% increase in time spent in drought conditions by 2030-2050 and up to 10% by 2070-2090, Figure 11 (Clark et al., 2011). With the more severe SSP scenarios, the frequency, duration and severity of droughts and wildfires will likely be more significant.

Impacts of drought

The impacts of drought are economic, environmental and social. Periods of drought can cause reduced soil moisture and groundwater, which can flow on to result in diminished stream flow, crop damage, and general water shortage. Drought events often have cascading effects for other sectors, such as the agricultural sector, reducing productivity, stock health, and profitability. Buller's reliance on primary industries (39.7% of local GDP) which includes agricultural (≈18% local GDP), exacerbates the potential of drought risk (Development West Coast, 2021). Fire risk, as well as depleted water flow, can also be exacerbated by droughts. Drought can cause problems for hydroelectric power production, for example, at the Buller's Matiri hydroelectric plant.

Data currently available for the Buller District

NIWA has probabilistic projections of droughts at a national scale at 5 km resolution (Clark et al., 2011).

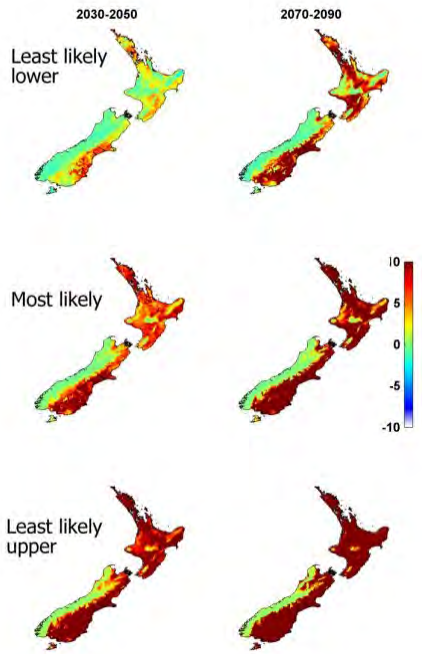


Figure 11: Projected increase in the percentage of time spent in drought from 1980-1999 levels for the A1B emissions scenario" (Clark et al., 2011).

Wildfire

Wildfires are unplanned fires in natural environments such as forests, shrublands and grasslands. Certain conditions increase the risk of wildfires, such as low rainfall, drought, high winds and fuel type (e.g. scrub vs dense forest).

Wildfire in the Buller District

Although Buller District receives some of the highest annual rainfall in New Zealand, it is not immune to fire risk. The West Coast experienced approximately 63 wildfires annually or 2.1% of New Zealand's total wildfires (New Zealand Drought Monitor, 2017).

Due to reduced summer rainfall frequency, the Buller District is likely to experience more frequent drought and fire conditions, especially near Cape Foulwind and inland areas. This is reflected in that current fire conditions are set to become more severe, with the mean length of the wildfire season increasing by two days (67%) across the West Coast by 2080-2095, relative to 2005-2020 (Melia et al., 2022).

Impacts of wildfires

Wildfires pose a significant threat to transportation, essential services, communications and supplies, through potential disruption or damage to infrastructure. They can also result in a decrease in air quality and the destruction of property, resources, natural environments and people.

Data currently available for the Buller District

Fire and Emergency NZ (FENZ) conducted a national wildfire hazard assessment in 2011 at a resolution of 25 metres. The affect of climate change is not included in this assessment.

Marine heatwaves

A marine heatwave is a period of abnormally higher water temperatures relative to the average seasonal water temperature of a particular region of ocean. Oceans absorb a large proportion of the earth's heat, so are highly exposed to temperature changes.

Marine heatwaves in the Buller District

The frequency of marine heatwaves is likely to increase into the next century. As oceans warm around New Zealand, the intensity of marine heatwaves is likely to increase 80-100% by 2100 (Bodeker et al., 2022). Ocean temperature is projected to rise by 1°C by 2045, and 2.5°C by 2090 (SSP5-8.5) (Lawrence et al., 2021).

Impacts of marine heatwaves

Economic activities such as 'Agric Support Services and Hunting', 'Fishing and Aquaculture', and 'Seafood Processing' equate to more than 2% of Buller's GDP (Development West Coast, 2021). A change in marine climate and ecosystems could affect the economic value of Buller's marine-based industries. Marine heatwaves are shown to adversely impact the mortality and spawning of fisheries such as pāua, kōura, as well as a plethora of other species (Lawrence et al., 2021). Changes in marine systems could also affect various Māori (e.g., mahinga kai values) recreational and social values.

Data currently available for the Buller District

National modelling of marine heatwaves with 17 km resolution projected to 2100 has been undertaken (NIWA, 2022).

4. Proposed risk domains and elements | Nga wāhi mōrearea

Risk is assessed across six wellbeing domains, based on the Treasury's Living Standards Framework: Human, Kaupapa Māori, Built, Natural, Economic, and Governance (Table 1). Risks specific to each of these domains are called subdomain risks, e.g. risk to the built environment domain includes risk to transportation and risk to potable water supplies. To assess these subdomain risks, we analyse the exposure and vulnerability of elements and indicators to the climate-influenced hazards. For example, one of the factors to consider when assessing risk to the transportation system is to understand how the state highway network (an element) is affected by coastal flooding (a climate-influenced hazard) under different sea level rise scenarios.

Table 1: The Wellbeing or value domains that will be assessed for their risk from climate change.

Pāpori | Human	Direct and indirect impacts on people.
Taiao hanga | Built environment	Vertical and horizontal infrastructure.
Te taiao | Natural environment	Aspects of the natural environment that support the range of our indigenous species, he kura taiao (living treasures), the ecosystems, and our blue-green infrastructure.
Kaupapa Māori | Cultural	Direct and indirect impacts on Tangata Whenua, and taonga.
Ohaoha | Economy	Set and arrangement of inter-related production, distribution, trade and consumption that allocate resources.
Mana whakahaere | Governance	The governing architecture and processes in and between government and economic and social institutions.

The subdomain risks and the contributing elements can be locally unique. Therefore, workshops were used to test and modify proposed subdomain risks and elements with community leaders and stakeholders. Having identified these elements and subdomains, the necessary data will be collected and the vulnerability assessed in the detailed risk assessment.

This list provides a starting point for the rigorous risk assessment. The subdomains and elements will be continually reviewed, refined, and added to, based on ongoing engagement (with council staff, stakeholders, and through future workshops) and as the understanding of the hazards and cascading risks improves.

4.1 Pāpori | Human

Pāpori, the human domain, reflects how climate change threatens our people and communities. Communities in the Buller District will face a range of hazards and some may have less ability to prepare for, respond to, and recover from these hazards than others. These capacities and community wellbeing is deeply tied into the built and natural environment domains and the subsequent risk assessment will consider indirect and cascading risks. This interconnectedness must be acknowledged when examining human factors (physical and non-physical) that relate to social vulnerability. The factors of social vulnerability that will be considered are explored through three key areas of society:

- Human: People's skills, knowledge, and physical and mental health
- Social: The norms, rules, and institutions of society
- Cultural: The knowledge, heritage, beliefs, arts, morals, laws, and customs of society

Throughout the adaptation planning process, we will engage with communities and provide opportunities to contribute and request information in order to best support those communities.

The proposed subdomains and associated elements are shown in Table 2.

Table 2: Risks to the Human Domain and the associated elements and indicators identified by workshop attendees

Sub Domain Number	Subdomain (Risk)	Elements
H1	Risk to social cohesion and community wellbeing (incl. mental health)	- Cemeteries - Community facilities - Number and demographics of people exposed - Number and demographics of people displaced - Mobility access - Economic index - Political index - Socio-cultural index - Population and demographic change
H2	Risk to physical health from exposure to hazards	- Number and demographics of people exposed - Family harm
H3	Risk of exacerbating and creating inequalities	- Number of Māori exposed - Number of Māori displaced - Number and demographics of people exposed - Number and demographics of people displaced - Availability and cost of housing - Percentage of rental population - Vulnerability (age, deprivation, addiction, health) - Disabled population - Cost of mitigation/retreat
H4	Risks to heritage and culturally significant sites	- Heritage buildings - Marae - Cultural practices - Urupā

Sub Domain Number	Subdomain (Risk)	Elements
		- Pa - Sites of cultural significance - Sites of archaeological significance
H5	Risk to accessing medical care and emergency services	- Health care facilities - Isolation from health care facilities - Disabled population - Capacity of healthcare
H6	Risk to accessing education	- Schools/early childhood education - Isolation from schools - Ability to access basic services (internet, electricity, 3 waters, cellular reception)
H7	Risk to accessing community services	- Community services (town hall, libraries, etc.) - Isolation from community services - Resourcing community services
H8	Risk to accessing food/resources	- Supermarkets - Isolation from supermarkets - Effects on community gardens/ ability to grow their own food. - Power, food, water, cooking - Getting together/meeting
H9	Risk to recreation	- Access to recreational sites - State/availability of recreational sites - Risks to recreational facilities, huts, tracks
H10	Risk to communications	- Telecommunications infrastructure - Residential internet access
H11	Risks to homes and personal assets	- Homes - Investments - Personal possessions

4.2 Taiao hanga | Built environment

Taiao hanga, the built environment domain, focuses on physical infrastructure and assets such as housing, transport, drinking water, waste and stormwater, energy and communications, landfills and coastal defences. The built environment is critical for human activities, supporting our communities and connecting people locally, nationally and internationally. Built assets support communities and are therefore intrinsically connected to the human domain as they provide shelter, drinking water, electricity to heat and cook with, and the ability to travel around the district.

The proposed subdomains and elements are shown in Table 3.

Table 3: Risks to the Built Environment domain and the associated elements/indicators.

Sub Domain Number	Subdomain	Elements
B1	Risks to potable water supply	- Water supply network pipes, pumps, station - Water supply catchment - Water supply extraction
B2	Risks to buildings (residential, commercial, industrial, and other structures)	- Boat ramps - Boat shed - Port buildings - Commercial buildings and facilities - Industrial properties and facilities - Jetties - Residential buildings - Community buildings - Tourism buildings - Accommodation - Hospital and emergency operating centres - Farm processing sites
B3	Risk to landfills and contaminated sites	- Contaminated sites - Landfills - Factories (e.g. cement factory) - Roads (material dependent) - Inactive storage tanks - Transfer stations
B4	Risk to wastewater and stormwater	- Coastal hazard defences - Riverine flooding defences - Septic tanks - Stormwater network pipes, pumps - Wastewater network pipes, pumps, stations, treatment plants
B5	Risk to transportation	- Bridges - Cycleways - Public roads - Railways - Service stations - State highways - Walkways/trails - Airport - Port - Isolation - Connectivity - Carparks
B6	Risk to electricity, energy and communications	- Electricity infrastructure - Gas infrastructure - Mobile towers - Service stations - Storage tanks

4.3 Te taiao | Natural environment

Te taiao, the natural environment domain (Table 4), reflects the risk of climate change on native and exotic flora, fauna and ecosystems on land and in freshwater and marine environments. This includes the implications for te whenua (the land), wai (water), te āhuarangi (the climate) and koiora (all living communities). As well as native and exotic ecosystems and flora and fauna, this domain includes green and blue infrastructure. The indigenous habitats that cover the district are he kura taiao (living treasures); they hold great ecological, cultural, and social significance.

Table 4: Risks to the Natural domain and the associated elements/indicators

Sub Domain Number	Subdomain	Elements
N1	Risks to indigenous terrestrial ecosystems and organisms	- Sites of ecological significance - Contaminated Sites - Landfills - Change in indigenous populations (diversity) - Mahinga kai (populations + access) - Cultural taonga and resources
N2	Risks to indigenous marine ecosystems and organisms	- Sites of ecological significance - Contaminated Sites - Landfills - Change in indigenous populations (diversity) - Mahinga kai (populations + access) - Cultural taonga and resources
N3	Risks to indigenous freshwater ecosystems and organisms	- Sites of ecological significance - Contaminated Sites - Landfills - Change in indigenous populations (diversity) - Mahinga kai (populations + access) - Cultural taonga and resources
N4	Risks to exotic ecosystems and species	- Sites of ecological significance - Sites with pest species - Sites with frequent international arrivals - Change in climate (e.g. alpine) - Connectivity of ecosystems
N5	Risks to parks and blue-green infrastructure	- Cemeteries - Parks, reserves, and sports fields - Community planting - Funding
N6	Risks to endangered species	- Sites of native species - Sites of endemic species - Number/distribution of native species
N7	Risks to natural structures, formations, and/or regimes (e.g. river channels)	- River formations and structures - Engineered structures - River beds
N8	Use of natural sites/recreation sites	- Access to sites - Number of opportunities
N9	Risk to mahinga kai and cultural resources	- Species diversity and population health - Access to resources and sites

4.4 Kaupapa Māori

The Kaupapa Māori domain is proposed to assess risk to Tangata Whenua, Māori communities, and Māori values. Further korero with Ngāti Waewae needs to be undertaken to determine the presentation of these risks as they are interconnected with the other domains. Kaupapa Māori refers to the collective vision, purpose and aspirations of Māori communities and Tangata Whenua. Thus, Kaupapa Māori encapsulates a more holistic, values-based perception of our environment, recognising the mauri (life force), mana (spiritual power/connectivity) and interconnectedness of all taonga (treasures) as per Te Ao Māori (a Māori worldview). Within the Kaupapa Māori domain, the interconnectedness of taonga (both physical and non-physical), the perspectives of Tangata Whenua, and Te Ao Māori will be considered throughout the adaptation planning process to ensure the outcomes align with and enhance these values.

The proposed subdomains and associated elements are shown in Table 5; these proposals are pending further engagement with Ngāti Waewae.

Table 5: Proposed risks to the Kaupapa Māori domain and the proposed associated elements/indicators

Sub Domain Number	Sub Domain	Elements
K1	Risks to Māori social and cultural wellbeing	- Cemeteries - Number of Māori displaced - Number of Māori exposed - Marae - Community facilities - Access to taonga - Ability for Māori customs to be undertaken - Financial abilities of Māori communities
K2	Risks to waiora - wellbeing/health	- Cemeteries - Marae - Impacts on te wai (the water) - Isolation from to taonga sites - Access to essential services - Access to community services - Access to kai/kai moana - Quality of life - Physical injury/mental health
K3	Risks to Māori cultural sites	- Marae - Pa - Wāhi taonga - Culturally significant sites - Archaeological sites of significance
K4	Risks to mahinga kai species and collection	- Sites of ecological significance - Number/amount of significant mahinga kai species affected - Number/amount of mahinga kai sites affected - Access to mahinga kai sites
K5	Risks to locality of Tangata Whenua	- Number of Māori affected/displaced

Sub Domain Number	Sub Domain	Elements
		- Connections between Māori communities and significant sites/other areas
K6	Risks to mauri, wairua and adaptive capacity	- Economic/Financial placement - Physical/Mental health - Cohesion of Māori communities - Access to sites of tapu - Environmental degradation
K7	Risks to Māori/Tangata Whenua autonomy/Te Tiriti rights	- Rights to access taonga - Rights under Te Tiriti - Autonomy of Māori people - Preservation of Māori culture, beliefs, and ideologies

4.5 Ohaoha | Economic

Ohaoha, the economic domain, encompasses the businesses, industries, and other drivers that contribute to the economic wellbeing and livelihoods of the communities within the district (Table 6). Risks to the built, natural, and human domains have the potential to cascade and disrupt economic activity.

Table 6: Risks to the Economic domain and the associated elements/indicators

Sub Domain Number	Sub Domain	Elements
E1	Risk of insufficient local government income/excess expenditure	- Rating base - Money spent on emergency operations - Money spent on recovery operations - Insurance costs or coverage - Central government support
E2	Risk of overall financial system (e.g. banks) instability	- Financial institutions performance - Credit/fund availability (business and homeowner)
E3	Risk to land-based primary sector viability	- Operating profit per hectare - Hectares of productive land - Months of production - Regional accessibility - Skilled workforce availability
E4	Risk to tourism sector viability	- Accessibility of key attractions, cycleways, and tracks - Number of hospitality venues - Number of tourism operators - Labour availability
E5	Risk to fisheries sector viability	- Fish stocks - Wharf and port functionality - Regional accessibility - Labour availability
E6	Risks to the insurability of assets	- Accessibility to insurance (availability and affordability) - Equity of access to insurance

Sub Domain Number	Sub Domain	Elements
E7	Risks to productivity due to supply chain and distribution system disruptions	– Roads, Bridges – Warehouses – Port – Airport – Railway line
E8	Risk to exacerbating economic inequality	– Income disparity – Deprivation – Economic diversity
E9	Risk to mineral sector	– Quantity of rare earth minerals – Availability of skilled workers – Profit per hectare – Accessibility to sites
E10	Risk to new industries (in particular technology)	– Internet access – Liveability/lifestyle – Reputation

4.6 Mana whakahaere | Governance

Mana Whakahaere, governance, is the steering architecture and processes of interaction and decision-making that exists in and between local and central government, and economic and social institutions. That is, it is the relationships between, coordination mechanisms for, and processes undertaken by the state, market and civil society to address collective issues (Driessen et al., 2012; Lange et al., 2013). Governance permeates all aspects of New Zealand, from the Treaty partnership between Māori and the Government (the Crown) to the relationship between local government and communities, from the economy to the built environment and natural ecosystems.

The proposed subdomains and risk indicators/elements are shown in Table 7.

Table 7: Risks to the Governance domain and the associated elements/indicators

Sub Domain Number	Sub Domain	Elements
G1	Risk of maladaptation due to processes not accounting for uncertainty and long-term change	– Guidance on infrastructure design and planning under uncertainty – Suitability of regulations (e.g. building code) to cope with climate change
G2	Risk that climate adaptation is not supported by institutions, processes, funding mechanisms	– Financial and guidance support from central government – Regional government support and collaboration – Planning process timeframes
G3	Risk of increased litigation	– Community discontentment – Transparent decision processes
G4	Risk of breaching Treaty obligations	– Community tolerance – Capacity of local iwi to support adaptation
G5	Risk of maladaptation due to knowledge and capacity gaps	– Skilled workforce – Higher education levels
G6	Risk that EM system will not adequately respond	– Funding for EM system – Skilled workforce

Sub Domain Number	Sub Domain	Elements
G7	Risk of doing nothing as elected members cannot agree or are not engaged in climate-hazard challenges	– Democratic process
G8	Risk of failure to follow democratic process due to frequency and scale of impacts	– Submissions to Council on LTP etc. – Staff numbers – Local government finance
G9	Risk of path dependency / sunk cost fallacy	– Money invested in 'hard' interventions
G10	Risk of loss of community trust and buy-in	– Guidance on infrastructure design and planning under uncertainty – Suitability of regulations (e.g. building code) to cope with climate change

5. Opportunities | Whai wāhitanga

While the previous section focused on adverse risk, there is also the potential for opportunities arising from climate change impacts and our response to these. The engagement process also sought to identify these opportunities, which are presented in Table 8. These opportunities are specific to the Buller District. Although they have not been explored in detail, recognising the potential pathways is a step towards building a climate change resilient community.

Table 8: Opportunities identified within each domain

Domain	Opportunities
Pāpori | Human	• Opportunity for creative planning • Opportunity for growth • Opportunity for community health growth • Opportunity for Māori engagement and leadership • Opportunity for Pākehā and Māori collaboration and mutual understanding • Opportunity for coordinated community adaptation strategies • Opportunity to develop cultural and community support/engagement centres • Opportunity to improve local services and community (e.g., healthcare) • Opportunity to build safer and more healthy housing • Opportunity for technological advancement
Taiao hanga | Built environment	• Opportunity to lead the national conversation around the climate transition • Opportunity to present ourselves as a top desirable location • Opportunity for master planning: where and what does the future look like • Opportunity for sustainable development through risk management • Opportunity to build future infrastructure's resilience to hazards • Opportunity to rethink blue green infrastructure • Opportunity to rethink future land use
Te taiao | Natural environment	• Opportunity for co-benefits of wetlands and other natural environments/ecosystems • Opportunity to expand, restore and enhance ecosystems • Opportunity for nature-based solution employment • Opportunity for restoring native - exotic balance • Opportunity to reconnect natural ecosystems • Opportunity for environmental education • Opportunity for sustainable agriculture integration • Opportunity for carbon sequestration
Kaupapa Māori | Cultural	• Opportunity for Pākehā and Māori collaboration and mutual understanding • Opportunity to enhance Māori values across the community • Opportunity to enhance Mahinga Kai
Ohaoha | Economic	• Opportunity for prosperity and creation of industry and jobs from climate mitigation and adaptation strategies • Potential for new industries
Mana Whakahaere | Governance	• Future focused and relevant policy/legislation • Opportunity to increase standards across the board

6. Next steps and recommendations | Nga mahi panuku me nga tohutohu

As shown in Figure 3, this report will be used to support and inform the following project stages:

Stage 4a - Gap analysis

A gap analysis was performed to identify what data is already available at an appropriate scale to undertake a risk assessment for the Buller district,

Stage 4b - Hazard assessment

The hazard assessment is necessary to develop spatial models of the extent and severity of different hazards under different climate scenarios. Existing hazard modelling will be collated and evaluated for its suitability for use in this climate risk assessment; necessary considerations include whether a sufficient range of climate scenarios are modelled and whether the extent encompasses the district. Subsequently, and based on resource availability, hazard modelling will be commissioned from specialist modellers such as NIWA, GNS, Aqualinc, and others. The climate scenarios and data format must be decided and consistent between hazard models for subsequent integration into the risk assessment. In tandem with the hazard assessment, data for the identified elements will be collated. This includes spatial information for infrastructure assets as well as sites of ecological and cultural significance.

Stage 5 and 6 - Risk assessment and prioritisation

The comprehensive risk analysis will utilise the outputs of the Stage 4 hazard assessment as well as the subdomains and associated elements proposed in this report. This stage will be presented as an interactive online tool (Figure 12, Figure 13) that enables an increased understanding and communication of risks within the Buller District. Specifically, this work will integrate both direct and indirect risks, including the consequence, uncertainty (including evidence and strength of knowledge assessments from key stakeholders), criticality and vulnerability.

The Risk Explorer (Figure 12, Figure 13) will include both spatial and temporally varying risk information for each domain, subdomain, and element within the Buller District. This information will enable risk-informed community engagement, adaptation decision-making, asset management, strategic land use planning, and internal and external reporting. Additionally, the nature of the Risk Explorer allows for an iterative yet consistent platform to communicate risk to numerous stakeholders whilst enabling the Buller District Council to update its risk information as new information, data, or research and methods become available.

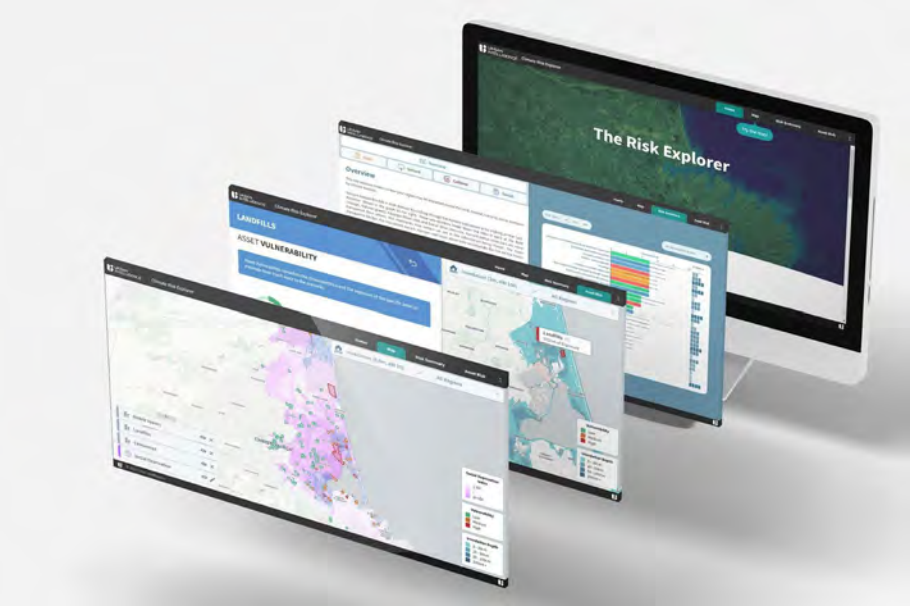


Figure 12: Stage 5 and 6 deliverables, the Risk Explorer, is used to communicate the findings of the detailed risk assessment.

Figure 13: Risk prioritisation: The Risk Explorer includes a ranking of consequences alongside the strength of evidence so that risk can be prioritised and easily reported. This is an example for the Built Environment domain, and the Explorer enables the user to view how this changes for different scenarios considering all of the domains or any single one.

Stage 7 - Adaptation planning

Due to the uncertainty inherent in climate change, decision making must be adaptive. Adaptive management involves flexible planning that recognises that interventions can fail once certain environmental conditions are reached. For example, an X-metre sea wall may only be suitable for less than Y centimetres of sea level rise; as SLR nears Y centimetres, this would signal that a new option is necessary and further increases would trigger a shift in strategy. Several approaches for decision-making under uncertainty are available (Lawrence et al., 2021), and there is ongoing research around the strengths and limitations of each for New Zealand communities.

Adaptive strategies will be combinations of different adaption options. These options are generally categorised as:

Maintain	We continue to live in an area, while increasing the community's risk awareness, environmental monitoring, and smart land-use planning.
Accommodate	We continue to live in an area by raising our tolerance to hazards. This could include adapting our buildings and infrastructure or managing stormwater and groundwater.
Protect	We protect our assets and homes from hazards through natural or engineered interventions such as seawalls or beach renourishment.
Relocate	We support and encourage the community to relocate away from hazardous areas. This involves leadership and signalling from the government through the location of new activity centres such as schools or hospitals (and other investment), and buyout or leaseback schemes to enable homeowners to move.
Avoid	We avoid investing in at-risk areas by using planning tools such as zoning or setbacks.

Once a suite of evaluation options has been identified, they can be evaluated for their risk-reduction effectiveness, cost feasibility, emission-reduction potential, and their impacts (co-benefits or trade-offs) across all of the societal wellbeing domains outlined in Section 2.

Based on the effectiveness and cost feasibility of the options, adaptive pathways must be developed with, not for, the communities. This will involve significant and likely ongoing community engagement. This will be conducted using a diverse group of community and rūnanga representatives from each of the (to be) identified adaptation areas. Some district-wide representation should also be included as well as youth voices where possible. The role of this community group is to provide informed recommendations to the Council on adaptation options that allow the community to respond to changes over time. The engagement in each adaptation area will be supported by a technical advisory group (TAG) that will aid with the creation of adaptation pathways. Members of the TAG are experts in their fields from across a number of agencies and are able to provide information, advice and guidance to support climate-related decision-making.

Together, this climate change adaptation programme will provide the Buller District with the evidence base to transition towards a sustainable and resilient community. The outputs will have benefits beyond adaptation planning, enabling informed asset management, spatial planning, and hazard management. There are huge opportunities if Buller District positions itself as one of the leaders of New Zealand's climate change transition.

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8. Appendices | Āpitihanga

Appendix A: Workshop attendees

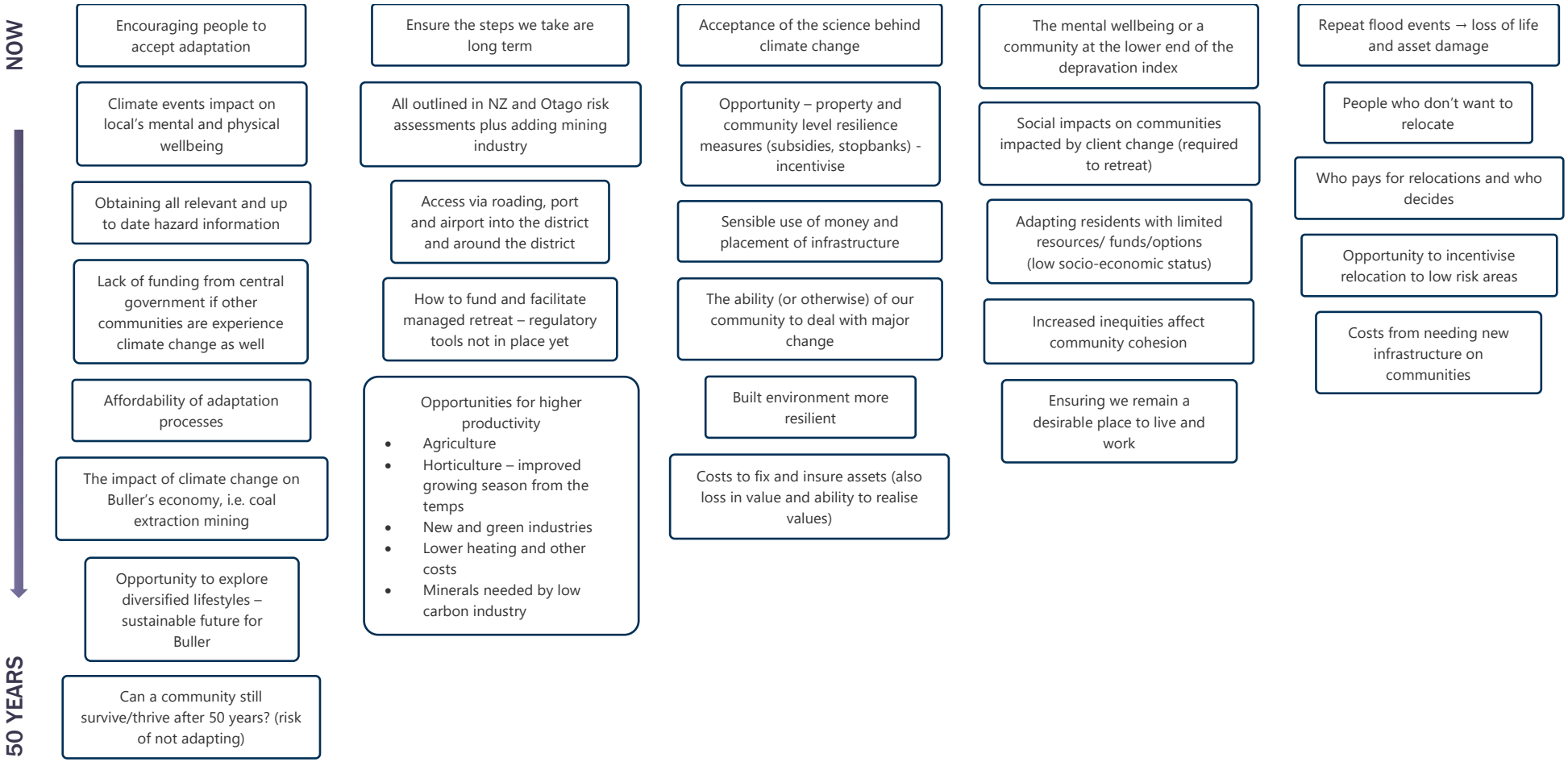
Table 9: Representatives able to attend initial engagement workshops and invited persons

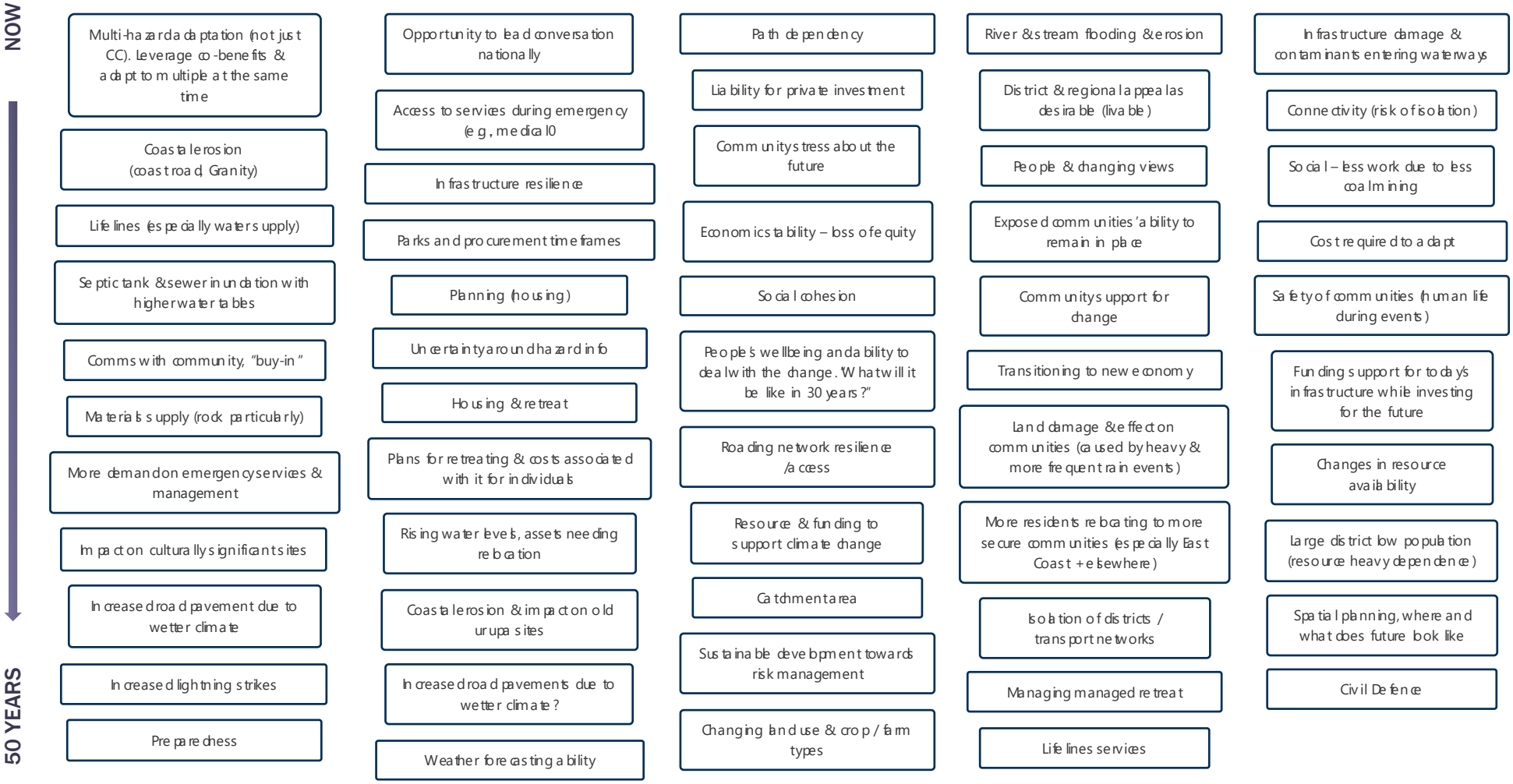
DOMAIN	ATTENDEES	INVITED BUT UNABLE TO ATTEND
Natural environment	Scott Freeman & Suvi van Smit (DOC) Heath Milne (DWC & Tourism West Coast) Pip Lynch (Ngāti Waewae) Debs Martin (TNC online attendance)	Sean Judd (BDC) Rachel Vaughan (WCRC) Francois Tumahai (Ngāti Waewae) Ned Tauwhare (Ngāti Waewae) Zak Shaw (DWC) Erik van Eyndhoven Laura Coll John Hill
Built environment	Mike Duff, Mike Williams, Sean Judd, & Paul Zaanen (BDC) Pip Lynch (Ngāti Waewae) Clark Nelson (BEL) Colin Hey (Waka Kotahi) Jamie Cleine (BDC Mayor) Jonathan Jull (NEMA online attendance)	Oliver Prescott (KiwiRail) Francois Tumahai (Ngāti Waewae) Ned Tauwhare (Ngāti Waewae) Tom Williams (MoE) Carissa du Plessis Sean Judd (BDC) Jo Armstrong (TTPP)
Human environment	Marg Lilly (Aged Concern) Maraea Casey (Flood Recovery Navigator) Pip Lynch (Ngāti Waewae) Lorraine Scanlon (Home Builders) Steph Newbury & Shayne Barry (Flood Recovery BDC) Phil Rutherford, Dave Hawes , Rosalie Sampson (BDC Councillors) Diane Longstaff (WCDHB)	Francois Tumahai (Ngāti Waewae) Ned Tauwhare (Ngāti Waewae) Jane George (WCDHB) Tui Marama (Youth rep) Bob Dickson (Recovery) Phil Wheble (WCDHB) Mikaere Clarkson (Kawatiri Youth Voice)
Economy	Richard Tacon (Bathurst) Heath Milne (DWC) Jamie Cleine (BDC Mayor) Krissy Trigg (BDC) Penny Bicknell (Flood Recovery BDC) Pip Lynch (Ngāti Waewae)	Lyn Carmichael (MPI) Francois Tumahai (Ngāti Waewae) Ned Tauwhare (Ngāti Waewae) Cheyanne Amai (Talleys) Ray Mudgway (Westland Mineral Sands) Katie Milne (World Farming Organisation) Rod Fox (BDC) Jo Birnie (DWC) Mark Radloff (NBS)
Governance	Jo Howard, Phil Rutherford (BDC Councillors) Sean Judd (BDC) Pip Lynch (Ngāti Waewae) Pam Johnston (DIA online attendance) Suzy Paisley (NEMA online attendance) Rachel Townrow (BDC, in part) Jamie Cleine (BDC Mayor, in part)	Francois Tumahai (Ngāti Waewae) Ned Tauwhare (Ngāti Waewae) Sharon Mason (BDC CE) Grace Hall (LGNZ Director) Lisa Marquat (MfE / NCC) Sarah Anderson (MfE)

Appendix B: Impacts identified over the next 50 years

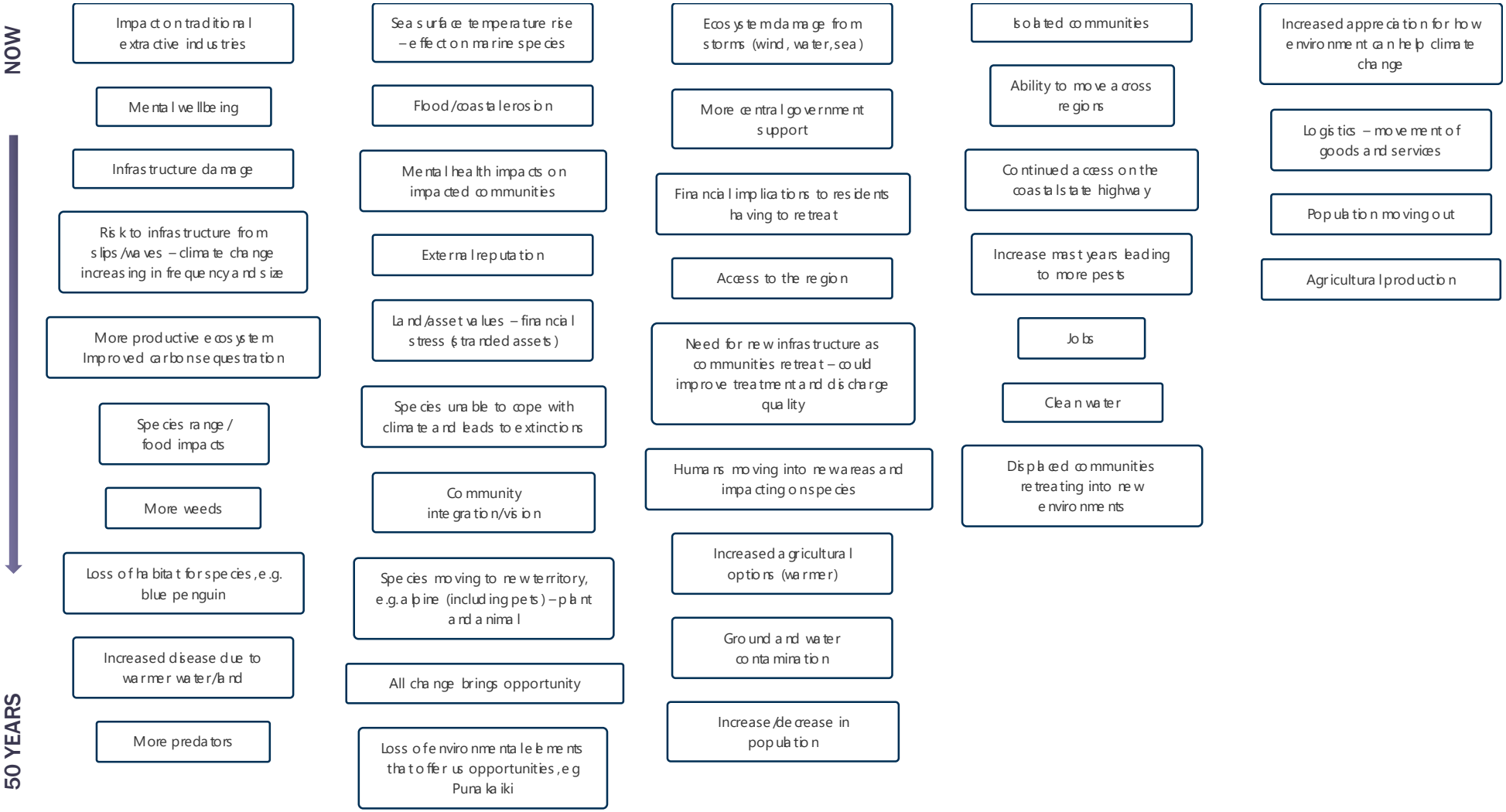
This appendix includes the ideas shared by the participants in the workshops. They are included verbatim as a record of this process and have been reflected throughout the report.

Biggest threats – overall



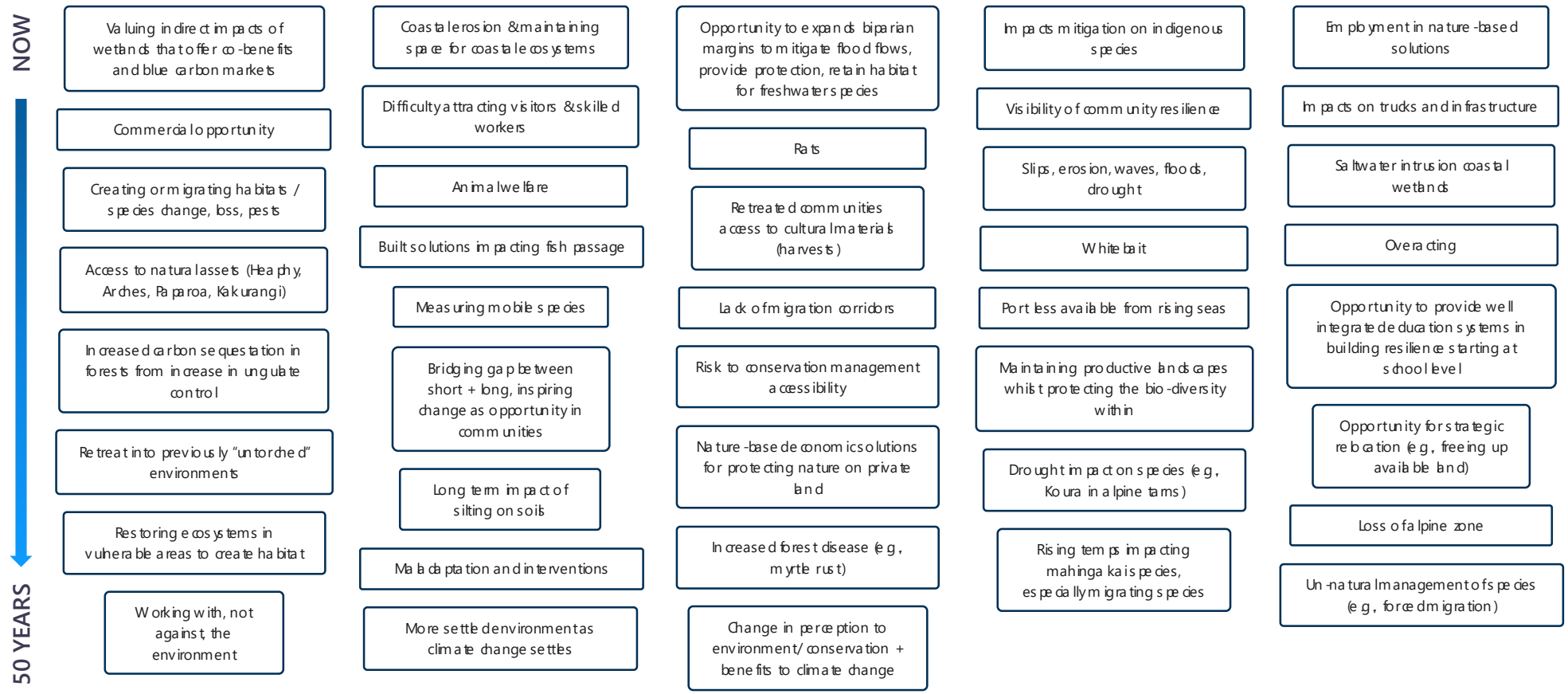

NOW
50 YEARS
Multi-hazard adaptation (not just CC). Leverage co-benefits & adapt to multiple at the same time
Coastal erosion (coast road, Granity)
Life lines (especially water supply)
Septic tank & sewer inundation with higher water tables
Comms with community, "buy-in"
Materials supply (rock particularly)
More demand on emergency services & management
Impact on culturally significant sites
Increased road pavement due to wetter climate
Increased lightning strikes
Prepare chess
Opportunity to lead conversation nationally
Access to services during emergency (e.g., medical0
Infrastructure resilience
Parks and procurement timeframes
Planning (housing)
Uncertainty around hazard info
Housing & retreat
Plans for retreating & costs associated with it for individuals
Rising water levels, assets needing relocation
Coastal erosion & impact on old urupa sites
Increased road pavements due to wetter climate?
Weather forecasting ability
Path dependency
Liability for private investment
Community stress about the future
Economic stability – loss of equity
Social cohesion
People's wellbeing and ability to deal with the change. "What will it be like in 30 years?"
Roading network resilience /access
Resource & funding to support climate change
Catchment area
Sustainable development towards risk management
Changing land use & crop / farm types
River & stream flooding & erosion
District & regional appeal as desirable (livable)
People & changing views
Exposed communities' ability to remain in place
Community support for change
Transitioning to new economy
Land damage & effect on communities (caused by heavy & more frequent rain events)
More residents relocating to more secure communities (especially East Coast + elsewhere)
Isolation of districts / transport networks
Managing managed retreat
Life lines services
Infrastructure damage & contaminants entering waterways
Connectivity (risk of isolation)
Social – less work due to less coal mining
Cost required to adapt
Safety of communities (human life during events)
Funding support for today's infrastructure while investing for the future
Changes in resource availability
Large district low population (resource heavy dependence)
Spatial planning, where and what does future look like
Civil Defence


NOW
50 YEARS
Opportunity to create a central cultural evacuation hub to create a sense of connectiveness, safety, and wellbeing.
Challenge of lack of living accommodation
Collaboration – doing things **with** people not **to** them.
Coastal erosion – isolated communities and access to those communities
Increase in mental health and psychosocial issues
Ability for supplies to get to people in emergency events
High risk to communications / power networks with weather events
Loss of lives and properties
Economic base effects – tourism, farming.etc.
Challenges
Uncertainty/unknown
Time taken for planning
Risking cost
Emotional stability
Accepting climate change
Retreat from vulnerable locations will be an issue of affordability for many
Opportunity to investigate and explore new paths of employment, specifically for our communities.
Opportunity to create new areas for social economic growth
The mental wellbeing of a significant portion of our community is a current issue
Healthy home initiatives
Mental health services in Buller for stressed people, help needed. Those that cannot settle in heavy rain.
Agreeing the way forward. No value in indecision or infighting.
Access on roads due to flooding and storms
Changeable weather impacting farming
#8 wire thinking will help us adapt
Better public transport within district - rail
Buller has many of the elements that will be most affected by a changing environment
We get to redevelop our town, our community
Challenge of Te Ao Māori world view re natural resource and habitats
Challenge – employment opportunities above the living wage
Cost of dealing with the present effects – cost of research with no implementation. Effect mentally on many of our communities.
Clean water supply
Overflows of sewage and stormwater into waterways
Working with barriers – vulnerable people making unsafe decisions because of personal situation / health / finances – geographic isolation
Work 'with' people – inclusive invite to be part of the journey
Capacity of emergency services due to increase events
Opportunities
Genuine collaboration
Transparent communication
Build trust and confidence
Build psychological wellbeing
Better living conditions due to new homes means healthier people
Challenge of vulnerable residents – social economic
Vulnerable people moving into risk prone areas
Community already stressed. People and resource already stressed.
Increase/decrease in population
AF8 earthquake
Low socio-economic area
Coastal communities
An aging population that does not necessarily understand the impacts
Biggest risk/challenge is getting cohesive action, ie. working together – also biggest opportunity
More cohesive community
Transport infrastructure – roads/airport
Communities needing to retreat and the impacts on their investments
Self-sustainable living!
AF8 earthquake
Opportunity to begin integrating understanding of Te Ao Māori world view.
Challenge of no central evacuation centre to cater for residents fully functional
Coal fires effect on atmosphere and health
Enough healthcare workers for all areas
Isolation
Low rating base – district has limited resources
The district has a high index of deprivation
High %aged population
Multiple risks from sea, river, slips, etc.
Challenge of process for making decisions. Opportunity for collaborative and inclusive governance
Loss of roads along the coastline – isolating communities
Improved infrastructure of treatment of wastewater in retreated communities

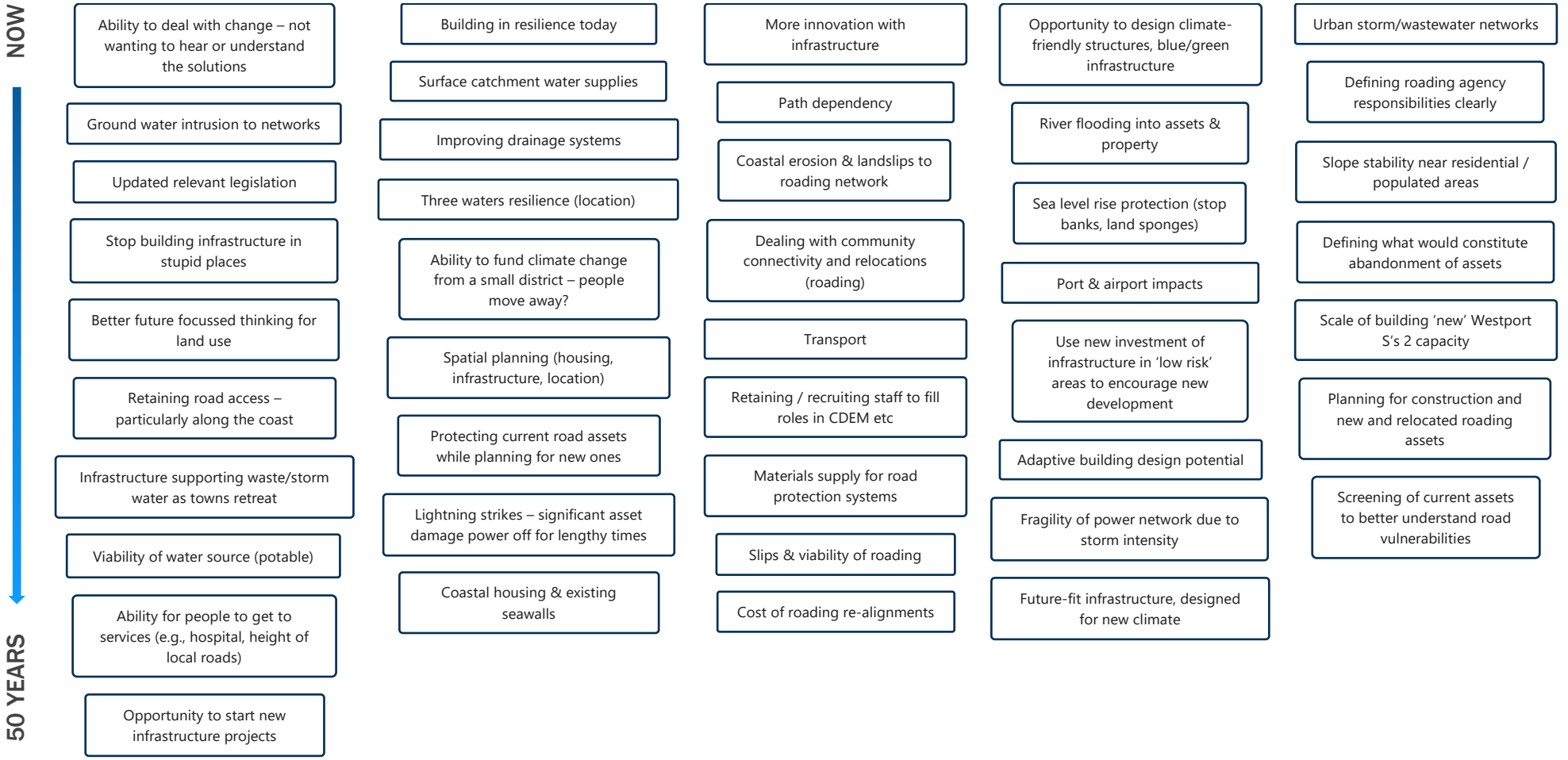

NOW
50 YEARS
Impact on traditional extractive industries
Mental wellbeing
Infrastructure damage
Risk to infrastructure from slips/waves – climate change increasing in frequency and size
More productive ecosystem Improved carbon sequestration
Species range / food impacts
More weeds
Loss of habitat for species, e.g. blue penguin
Increased disease due to warmer water/land
More predators
Sea surface temperature rise – effect on marine species
Flood/coastal erosion
Mental health impacts on impacted communities
External reputation
Land/asset values – financial stress (stranded assets)
Species unable to cope with climate and leads to extinctions
Community integration/vision
Species moving to new territory, e.g. alpine (including pests) – plant and animal
All change brings opportunity
Loss of environmental elements that offer us opportunities, e.g Puna kaiki
Ecosystem damage from storms (wind, water, sea)
More central government support
Financial implications to residents having to retreat
Access to the region
Need for new infrastructure as communities retreat – could improve treatment and discharge quality
Humans moving into new areas and impacting on species
Increased agricultural options (warmer)
Ground and water contamination
Increase/decrease in population
Isolated communities
Ability to move across regions
Continued access on the coastal state highway
Increase mast years leading to more pests
Jobs
Clean water
Displaced communities retreating into new environments
Increased appreciation for how environment can help climate change
Logistics – movement of goods and services
Population moving out
Agricultural production

Biggest threats from a domain perspective

Natural environment



Built environment



Human


NOW
50 YEARS
Need places to go → evacuation centre. Focus on safety for people
Opportunity for creative planning for future
Funding
Get people to accept and understanding – agree way forward
People contributing to society
Health is not just the responsibility of a DHB
High deprivation means most people's investment is in their homes. Risk to homes = lack of financial options
Neighbour support
Greater potential for tech-based economy
Transparent communication
Changing dynamics to towns as people move inland
Old housing stock will be removed in flood/hazard areas, meaning newer (healthier) homes
De/increase in population
Ability to access emergency services
Medical care – mental health not able to deliver
Working together
Marketing opportunity for growth if we become a progressive community
Potential for Westport to be part of "Blue Highway"
Post-traumatic growth/resilience building
Cheap housing in District attracts people from lower socio-economic sector into high risk areas
Strong governance
Opportunity to create resilience invest in local support agencies & NGOs
Exodus from the district due to uncertainty
Build safe and better
Māori protocols of the natural environment
Can health services cope? Roads blocked, no way in.
Diminishing values
Protect against the immediate effects where possible
Support those affected most to adapt and accept
Changes in population (including increase in retirees)
Loss on equity in home due to flooding risk
Higher percentage of vulnerable people (age and beneficiary)
Working together
Opportunity to gradually move people to safer areas
Changes to natural environment (flora & fauna, tourism)
Wraparound services for all the community, especially the tamariki
Very poor health services within the region
Impacts on physical & mental health / opportunity to teach people about looking after mental wellbeing
Isolation
Worries of where to go to higher ground if needed more communication
Wouirua
Less able bodied people to do full complement of tasks
Navigators to walk alongside/with people
Financial implications from retreat
Risk to commercial investment & jobs
Opportunity for long-term community navigators to help people with adaptation options
Uncertainty of monetary value on properties
Opportunity for Māori understanding opening conversation
Being prepared for long lengths of isolation
Limited communications
Whanau relationship breaking down
Social connection
Global shortage of healthcare workers
Homelessness/loss of possessions
People feeling stuck - having no choice to improve their wellbeing
Need for adaptability in planning
Loss of cultural sites, particular in coastal areas
Develop a permanent community cultural hub/evac centre to support our communities
Cultural understanding of wellbeing
Vibrant community with health services available for all

Economic

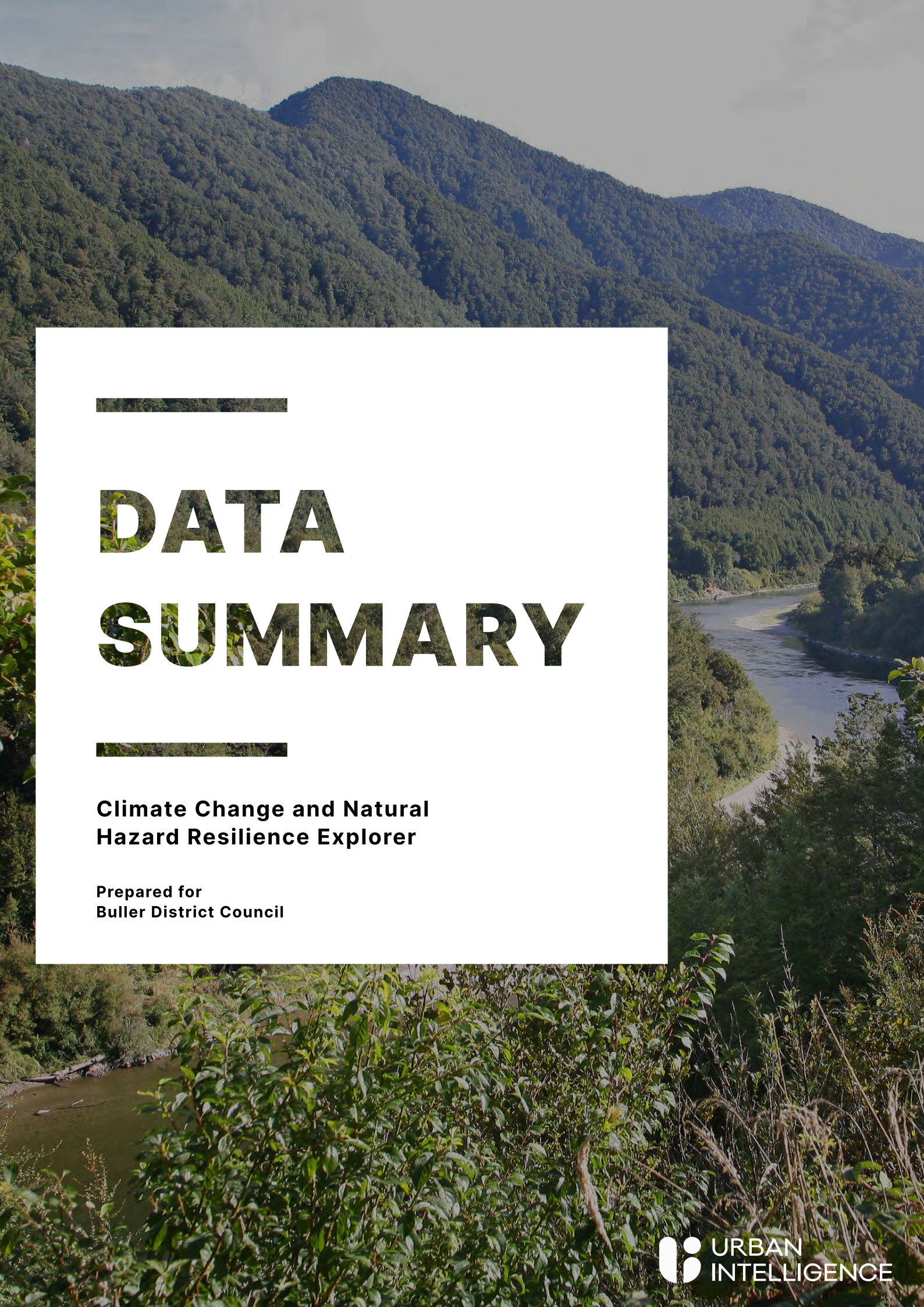
NOW

50 YEARS

- Agricultural sector events impact
- Agricultural sector productivity and input costs
- Access to funds to grow/establish business due to negative sentiment.
- Pressure on traditional industries
- Need for business community/innovation thinking within Buller – future thinking
- Tech development
  - growth in remote working
  - SAAS – international opportunities
  - smart technology/AI
- Uncertainty around number of tourists coming if we are cut off
- Opportunities for new development
- Tourism – what will bring people here?
- De-carbonisation policy
- Migration – skilled workforce
- Transport costs rising
- Ability to add value locally – coal/HMS (blue carbon)
- Volatility in commodity markets
- Renewable energy investment
- Jobs – creating employment through the process
- Training and education
  - upskill population
  - training from school age to retain youth
  - retraining for a new era
- Opportunity to 'redesign' coastal margins
- Opportunity to learn from similar "new" climate areas – what works for them now.
- Educating all ages – how to reach all groups/ bring next generation on journey
- Transport infrastructure movement of goods
- Ability to access central government funding when all of NZ is impacted
- Engineering – high tech opportunities and building on current strengths
- Shaping a 'new' town / moving a town/district
- Coastal effects damage tourism
- New agricultural opportunity - crops
- Skills shortage to support business
- Costs associated with retreat and new infrastructure
- Impact on already low productivity
- Investment in infrastructure
- How will we protect supply chains? Build resilience to lifelines?
- Primary industry – horticulture, aquaculture opportunities?
- Port reliability
- Self-sufficiency – food – water - employment
- Local focus business (needs population)
- Movement of people to seek work out of the area
- Lack of certainty reduces home ownership
- Imposed regulatory costs
- Tourism
  - Opportunities - eco/environment
  - new product
- Impacts on finances if access to mahinga kai and cultural materials decreases
- Port development – import/export
- Prioritising adaptation investment
- Digital economy – positive and negative
- Competitive advantage post extractives

Governance


NOW
50 YEARS
Better understand local government roles
Opportunity to link the risk of adaptation assessment with the TTPP into a shared government structure
Climate change must be front and centre for future councils
West Coast media is highly politicised
Community acceptance of the changes needed
Need to be well informed and backed with science
Greater collaboration with central government
Changes in the way local government is organised
Local government won't be able to access as much funding from central government
Opportunity – Buller recovery steering group has provided a forum to bring different levels of government together
Governors must have a good understanding and buy-in to the impacts of change
Low community awareness and engagement
Opportunity to form a better relationship and integrated governance between central, regional, local and iwi
How to get the full voice of the community – not just the squeaky wheel
Lack of capacity to effectively respond
Climate and flood risk do not recognise geographical/ political boundaries, e.g. Buller vs West Coast
Risk of maladaptation litigation due to inadequate action /mistiming.
Greater community consultation
Opportunity to make media your climate change/risk awareness allies
Solution focused
Ability for institutions to follow decision making processes with increased frequency and scale of events
Ngāti Waewae will be partners in decision making
Risk of increased damage costs and insufficient financing
Risk of conflict disruption and loss of trust
Limited funding in small community – low rating base and possibly declining
Capability, capacity, financing, uncertainty, gaps in knowledge, communication, leadership, cultural aspects
Political environment – climate deniers are outspoken in this region
A lot of new infrastructure may be needed in a short timeframe
Potential communication issues – lose touch with affected communities
Decisions will need to be made based on limited/incomplete information
Natural leaders will step up within their communities
Existing planning decision making and legislative frameworks inadequate
Decisions based around electoral cycles
Imperative that councils work collaboratively – central government, NGOs, etc.
Ability to change outcomes for the better
Communities could become more self-sustaining
Decisions and planning will need to occur to determine where communities can retreat to
District could be a leader in producing green energy – hydrogen production
Competition for resources – loss of value in assets
Services being impacted by climate change



DATA SUMMARY

Climate Change and Natural Hazard Resilience Explorer

Prepared for
Buller District Council

URBAN INTELLIGENCE

Data Summary

Prepared by: Urban Intelligence Ltd.

Revision	Description	Date
Version 1.0	Initial summary of the existing data	March 18, 2024

Ihirangi | Table of Contents

Kuputaka | Glossary

Term	Definition
Adaptation	The process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities [1].
Adaptive Capacity	The system's ability to adjust to moderate negative consequences or maximise positive consequences [1].
AEP	Annual Exceedance Probability. The probability that an event of a certain size or greater will occur in a given year.
Consequences	The positive and negative outcomes or impacts that result from interaction with a risk source or an event [2].
Criticality	The relative importance of a system aspect (e.g., road, electrical substation, etc.) to the functionality of the system as a whole.
Domain	Wellbeing or value domains are a hybrid of the NZ Treasury's Living Standards Framework and group values, assets, and systems that could be affected by climate change. These domains were defined and used in the first NCCRA.
Element	The assets, taonga, people, places, and specific systems that may be at risk.
Exposure	The state or condition of being subjected to or encountering a risk source, which can occur in a binary manner where one is either exposed or not, or in a continuous manner where the level or intensity of exposure varies [2].
Fragility	The system's likelihood to experience negative consequences.
Interest	Risk is assessed to what is valued and the interests are these values, e.g., 'the tourism sector' or 'transportation'.
IPCC	Intergovernmental Panel on Climate Change.
Hazard	A natural or human-induced event or trend that has the potential to cause consequences.
Mitigation	The process of reducing the severity of climate change through emissions reduction or carbon sequestration.
NAP	National Adaptation Plan.
NCCRA	National Climate Change Risk Assessment.
RCP	Representative Concentration Pathway. Representing various climate change scenarios based on differing levels of atmospheric carbon.
Risk	The consequences and associated uncertainties [2].
Risk Source	An entity, activity, or condition that has the potential to generate risk [2].
Resilience	The capacity and characteristics of a system that reduces negative consequences.
Resilient	A system is judged to be resilient if the negative consequences and their associated uncertainty is considered acceptably low.
Scenario	A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of decisions [1].
Sensitivity	The degree to which something is impacted by hazards.
SSP	Shared Socio-economic Pathways (SSPs) are scenarios of projected socio-economic global changes up to 2100 as defined in the IPCC's Sixth Assessment Report on climate change in 2021. They are used to derive greenhouse gas emissions scenarios with different climate policies. They also describe the challenges for mitigation and adaptation to climate change under different levels of development and cooperation.
Uncertainty	Imperfect or incomplete information/knowledge about a hypothesis, quantity, or occurrence of an event.
Vulnerability	The system's susceptibility to negative consequences.
Vulnerability Function	A mathematical function that describes the relationship between the intensity of a hazard and the percentage loss or damage to a specific element. This is contrasted with a fragility function, which is the relationship between the intensity of a hazard and the probability of loss or damage to a specific element.

1 Pūtake | Purpose

The purpose of this document is to provide an overview of the Buller Resilience Explorer and a summary of the data required and the data currently included.

Please review the data requirements and provide any additional data that you would like to include in the Resilience Explorer. Additionally, if there is data that currently is included that could be sourced from a more appropriate or up-to-date source, please let us know.

2 Whakatakinga | Introduction

Kia ora and welcome to the community of users for the Resilience Explorer.

The Resilience Explorer is a web-based platform that provides a comprehensive understanding of the known physical risks facing your community. It is designed to be a tool for local government, iwi, and other stakeholders to understand the risks facing their communities and to support the development of adaptation strategies. It is designed to be a tool for infrastructure and asset managers who need to understand the conditions that their assets may experience now and in the future, or identify the suitability of potential sites. It is designed to be a tool for central and local government policy makers who need to develop frameworks and investment strategies to support the resilience of communities and infrastructure. For effective and efficient adaptation, it is critical that these users are basing their decisions on consistent and up-to-date risk information. The Resilience Explorer is designed to be a living dashboard, with the ability to update and add new data as it becomes available.

The motivation and ethos behind the development of the Resilience Explorer was to assist you in navigating a changing and uncertain future. The very nature of this uncertainty means it's impossible to pinpoint the 'perfect' tool upfront. Instead, we've created a dynamic tool designed to adapt alongside you. As new challenges are faced - whether by you or other users - the Resilience Explorer will be updated, enabling you to learn from others and share your own experiences.

Therefore, we encourage and welcome feedback on the Resilience Explorer and your adaptation experience and expert and local knowledge. This will help us to understand how the Resilience Explorer is being used and how it can be improved. If there are new data sources that you would like to see included, or if there are new features that you would like to see, please let us know. Equally, we will be seeking your input on proposed new features as they are developed, in order to ensure that they meet your needs. We are also actively involved in and aware of international research developments, so are ensuring that your community is supported with the best information and methods available.

2.1 Purpose of the Resilience Explorer

Risk arises when systems are exposed and vulnerable to risk sources or hazards (Figure 1). Actions that can be taken to reduce risk include reducing exposure through risk-informed land use planning or managed retreat, reducing vulnerability through building capacity, strengthening infrastructure, and developing recovery strategies, or reducing the risk source through mitigation or protective measures. Ultimately, these actions are about reducing the consequences of natural events when they occur, thus reducing risk. A risk assessment provides an evidence base for preparing for hazards and adapting to climate change. The analysis includes what, who, and (critically) where is exposed and vulnerable to those hazards. This information is critical for adaptation and resilience-enhancing decisions for your community, infrastructure, and economy.

Managing this risk, through building resilience / reducing vulnerability, or reducing exposure to hazards, is the goal of the Resilience Explorer. The tool can be used for a range of purposes, including:

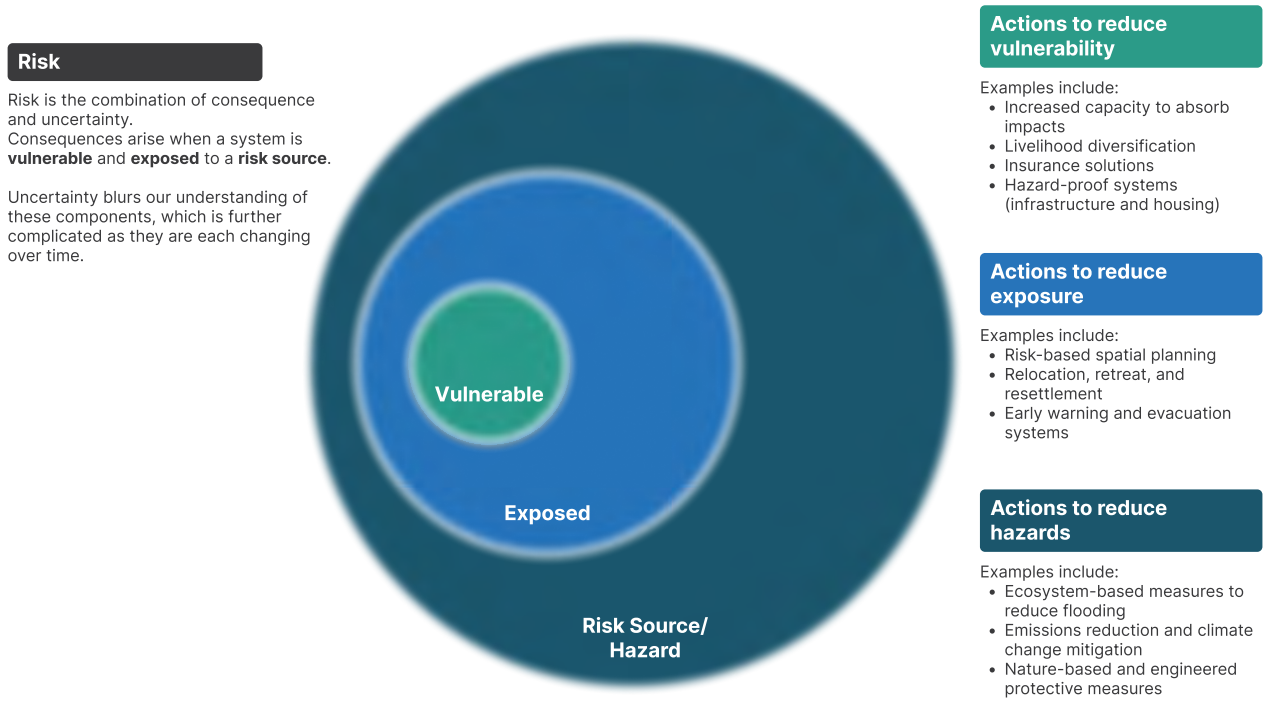


Figure 1: Risk arises when systems are vulnerable and exposed to certain risk sources or hazards. Image adapted from [2–4].

- Climate adaptation planning
- Infrastructure resilience planning
- Land use planning.

For example, critical to any of these purposes is identifying the most vulnerable areas and assets in your community, evaluating the potential benefits of different resilience intervention strategies, and prioritising areas for investment. These actions require a spatial understanding of the risks that hazards pose to the community, and an understanding of the vulnerabilities and capacities of the infrastructure, systems, and community to respond to these risks. Equally important is an understanding of the vulnerabilities and capacities of the community to respond to these risks - we call this contextual information. This combined understanding is critical for developing effective interventions.

2.2 Summary of Consequence Methodology

In this case, consequences to elements are assessed based on their exposure and, where possible, the resulting damage state. Exposure occurs when an asset comes into contact with a hazard. For example, if a building experiences coastal inundation that is 10cm deep, the building's exposure to coastal inundation is 10cm.

Exposure is calculated by spatially overlaying the hazard and element layers and calculating the intensity of exposure at each element. Element data is provided typically in one of three types and there are minor methodological differences when handling these: points, lines, and polygons. For points, the exposure is calculated at the provided latitude and longitude. For polygons, the exposure is calculated at points across the polygon (not just the centroid), and the 90th percentile of these exposure intensities is reported as the level of exposure. This ensures that the assessment is conservative, while also reducing the influence of

outliers arising from the uncertainty in the exposure intensity distribution (which may arise if the maximum were used). For lines, the line is first buffered by 10cm to create a polygon and the exposure is calculated accordingly.

The next step is to determine the implications of the intensity of exposure, that is, does it matter? In this case, a damage state is estimated. To do this, vulnerability or fragility functions are used. Vulnerability function indicate the likely damage ratio arising from that degree of exposure. Fragility function, on the other hand, indicate the probability of some level of damage, based on that degree of exposure. These function are related to the characteristics of the element. For instance, different building materials can make an element less vulnerable to a hazard and are used if the information is available.

3 Data Required

The Resilience Explorer is a living dashboard and is designed to be updated as new data becomes available. The data required for the Resilience Explorer is divided into three categories: elements, risk sources (e.g., hazards), and contextual information. The elements are things like assets, places, taonga, or other physical things that are valued by the community. The risk sources are the hazards or changing conditions that these elements are exposed to. The contextual information is the wider information that is relevant to the community's vulnerabilities and capacities to respond to these risks.

The following sections provide an overview of the data required for the Resilience Explorer.

4 Rawa | Elements

Elements are assets, places, taonga, and other spatial features that are valued by the community. These elements are the things that are exposed to the risk sources that are assessed in the Resilience Explorer. Depending on your needs and objectives (and recognising that these may change over time), different elements will be relevant to include in the Resilience Explorer.

The following is a list of example elements that can be included in the Resilience Explorer:

Infrastructure

- Critical Infrastructure: airports, ports
- Transportation: roads, rail, cycleways, bridges
- Property Information: buildings, ratings information, age, material, council housing
- Utilities: water, wastewater, stormwater, electricity, gas, telecommunications, wells and bores
- Existing Protection Structures: coastal barriers and sea walls, flood defences

Facilities

- Emergency Response: CDEM hubs, police stations, fire stations
- Community Facilities: libraries, parks, playgrounds, cemeteries
- Social Infrastructure: community housing
- Health Infrastructure: hospitals, medical centres

Natural and Environmental Assets and Factors

- Ecological Sites: native bird habitat areas, sites of significance, wetlands
- Contaminated Sites: landfills, etc.

Social and Cultural Assets

- Marae
- Schools
- Heritage sites
- Places of worship
- Community gardens

Economically Important Assets

- Commercial and industrial properties
- Tourism facilities
- Assets specific to key sectors
- Agriculturally Important Sites: farmland, highly productive land

This section lists the elements that are known and available to Urban Intelligence.

4.1 Boat Ramps

4.1.1 Boat Ramps (New Zealand)

A boat ramp, also known as a boat launch, is a structure designed to provide a smooth and controlled entry or exit point for boats and other watercraft into or out of a body of water, such as a lake, river, or coastal area. Boat ramps are essential for launching and retrieving boats without the need for specialised docking facilities.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attribute displayed on the Resilience Explorer where applicable for this layer is the ramp name.

This layer has not undergone any significant modification from its source.

Source

Provider: Toitū Te Whenua Land Information New Zealand

Date: 18/12/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://data.linz.govt.nz/layer/50241-nz-boatramp-centrelines-topo-150k/`

4.2 Bridges

4.2.1 Bridge Centerlines (New Zealand)

A bridge is a construction that spans a gap, such as a river or a road, providing a pathway for people and vehicles to cross. This layer includes all known road bridges, however, only includes foot and rail bridges that are significant in size or location.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the bridge name and use type of the bridge.

Source

Provider:	Toitū Te Whenua Land Information New Zealand
Date:	18/12/2023
License:	Creative Commons Attribution 4.0 International License
Source:	`https://data.linz.govt.nz/layer/50244-nz-bridge-centrelines-topo-150k/`

4.3 Cemeteries

4.3.1 Cemetery Points (New Zealand)

A cemetery is a designated area or plot of land that is set aside for the burial and commemoration of the deceased. These spaces are typically managed and maintained by cemetery authorities or organisations.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attribute displayed on the Resilience Explorer where applicable for this layer is the cemeteries name.

This layer has not undergone any significant modification from its source.

Source

Provider: Toitū Te Whenua Land Information New Zealand

Date: 19/12/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://data.linz.govt.nz/layer/50254-nz-cemetery-points-topo-150k/`

4.4 Doc Campsites

4.4.1 DOC Campsites

This layer contains locations of all DOC campsites. DOC campsites are places to relax, enjoy and explore the outdoors. Click here to see more information about staying at a campsite.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the site names, region, description, campsite category, number of powered/unpowered sites, bookability, facilities, activities you can do, landscape type, how you can access the site and DOC system ID.

Source

Provider: Herenga ā Nuku

Date: 12/12/2023

License: https://www.doc.govt.nz/our-work/maps-and-data/terms-nd-conditions/

Source: `https://www.doc.govt.nz/parks-and-recreation/places-to-stay/stay-in-a-hut/`

4.5 Doc Huts

4.5.1 DOC Campsites

This layer contains locations of all DOC huts and bivvies. DOC huts provide unique places to stay, refuge from bad weather, or rest and recover when you're out exploring the outdoors. Click here to see more information about staying in a hut.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the site name, place, region, bookability and facilities.

Source

Provider:	Herenga ā Nuku
Date:	12/12/2023
License:	https://www.herengaanuku.govt.nz/privacy/terms-of-use/
Source:	`https://doc-deptconservation.opendata.arcgis.com/datasets/7f7321caf77b4101b9573db4575dd794_0/explore`

4.6 Fire Stations

4.6.1 Fire Stations (New Zealand)

A fire station is a facility equipped to house firefighting apparatus, personnel, and equipment for the purpose of responding to emergencies involving fires and other hazardous situations.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the station name, address, phone number, and website.

This layer has been modified to combine duplicate fire station information and locations where found. In addition to this, the attribute for the website URL was changed to make it easier to use.

Source

Provider: Fire and Emergency NZ
Date: 31/01/2024
License: Creative Commons Attribution 4.0 International License
Source: `https://www.fireandemergency.nz/find-a-station/`

4.7 Historic Buildings And Structures

4.7.1 Historic Buildings and Structures (Buller)

A historical building is a structure of significant cultural, architectural, or historical value that reflects the heritage and evolution of a society. Its importance lies in preserving tangible connections to the past, offering insights into our ancestors' way of life, and enriching our understanding of cultural identity.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are types, location, criteria and build date.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://gis.westcoast.govt.nz/arcgis/rest/services/ResourceManagementAndPlanning/PlanningFeatures/MapServer/1`

4.8 Hospitals

4.8.1 Hospitals (New Zealand)

As described by the Ministry of Health, a hospital is a specialised healthcare institution or facility where medical professionals provide diagnosis, treatment, and care to patients who are experiencing illness, injury, or other health-related conditions. Hospitals play a critical role in the healthcare system by offering a wide range of medical services, from emergency care and surgeries to diagnostic procedures, rehabilitation, and ongoing medical management.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the hospital name, type, sub-type, and estimated occupancy.

Source

Provider: NZ Ministry of Health
Date: 14/06/2021
License: Creative Commons Attribution 4.0 International License
Source: `https://data.linz.govt.nz/layer/105588-nz-facilities/`

4.9 Landfills

4.9.1 Landfills (New Zealand)

A landfill is a designated area of land where waste materials are disposed of and buried. It is a method of waste management in which solid waste is placed in layers and covered with soil or other materials to reduce environmental impacts and promote safe decomposition. Landfills are commonly used for the disposal of municipal solid waste (MSW), which includes household waste, as well as certain types of non-hazardous industrial and commercial waste. Landfill data in New Zealand is generally incomplete, so expect there to be more landfills than are shown.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

Source

Provider: Toitū Te Whenua Land Information New Zealand

Date: 18/08/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://data.linz.govt.nz/layer/50294-nz-landfill-polygons-topo-150k/history/`

4.10 Marae

4.10.1 Marae (New Zealand)

A marae is a fenced-in complex of carved buildings and grounds that belongs to a particular iwi (tribe), hapū (sub-tribe) or whānau (family). Marae are used for hui (meetings), āhuareka (celebrations), tangi (funerals), educational workshops and other important tribal events. A marae generally incorporates a wharenui (carved meeting house), a marae ātea (an open space in front), a wharekai (a dining hall and cooking area), and an ablution block.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the marae name, alternate name, wahrenui, type, location, Te Puni Kōkiri region, iwi, and hapu.

This layer has been modified to correct the incorrect geometry entry for one of the marae.

Source

Provider: Te Puni Kōkiri

Date: 15/06/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://hub.arcgis.com/maps/TPK::map-marae/about`

4.11 Medical Centres

4.11.1 Medical Centres (New Zealand)

A medical centre, also known as a medical clinic or health centre, is a facility where healthcare professionals provide a range of medical services to patients. These centres can vary in size and scope, and they may offer primary care, specialty care, or a combination of both. This layer contains only medical centres and not hospitals, as these are found under their own separate layer.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the centre name, legal name, address, phone number, former district health board, health facility code, head provider facility index ID, and organisation ID.

This layer has had the medical centres with duplicate and historic locations removed.

Source

Provider: Ministry of Health

Date: 27/08/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://services2.arcgis.com/9V7Qc4NIcvZBm0io/ArcGIS/rest/services/Enrolled_General_Practioners_in_New_Zealand/FeatureServer/0`

4.12 Mobile Towers

4.12.1 Mobile Towers (New Zealand)

A mobile network tower is a tall structure equipped with antennas that transmit and receive wireless signals. This allows for wireless communication between mobile devices, and the broader telecommunications network, and the provision of data services within the given geographic area. The three providers of towers in New Zealand are One NZ, 2degrees, and Spark, while the infrastructure itself is typically owned by Connexa.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the location name, cellphone carrier, and height above sea level.

Source

Provider:	Eagle Technology Group Ltd
Date:	12/05/2017
License:	Creative Commons Attribution 4.0 International License
Source:	`https://hub.arcgis.com/datasets/eaglegis::towers/explore?location=-40.879541%2C-7.082748%2C5.96`

4.13 Wastewater Network Stations

4.13.1 Wastewater Pumpstations (Buller)

A wastewater pump station is a facility that pumps used water and sewage from lower to higher elevations, enabling efficient transport to treatment plants. Its importance to society lies in preventing backups and ensuring proper sewage management, thereby maintaining public health, preventing environmental contamination, and promoting clean water resources.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are asset ID, asset type, ownership, community, install date, condition, accuracy, performance, criticality, description and status.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FWaterServices%2FSewerServicesPublic%2FMapServer&source=sd`

4.14 Parks And Reserves

4.14.1 Parks and Reserves (New Zealand)

A park or reserve is an area of land set aside for public use, enjoyment, and recreation. They are designed to provide people with access to outdoor spaces, greenery, and various recreational activities. This layer only includes council-owned parks and reserves available to the general public and therefore fields and parks that belong to schools and universities are not included.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the parcel intent, statutory actions, territorial authority, Departement of Conservation region, and area.

Additionally, the area has been gridded into hexagons approximately 110m in diameter, to allow for better identification of the area at risk.

Source

Provider: Herenga ā Nuku

Date: 27/10/2022

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/apps/mapviewer/index.html?url=https://services2.arcgis.com/b5ADKIcWivL5vNaV/ArcGIS/rest/services/Reserves/FeatureServer/0&source=sd`

4.15 Water Supply Pipes

4.15.1 Water Pipes (Buller)

A water pipe is a conduit used to transport clean water from its source to homes, businesses, and public facilities. Its importance to society is foundational, as it provides access to clean and safe drinking water, ensuring the health, hygiene, and well-being of communities and supporting various daily activities.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are asset ID, asset type, ownership, material, diameter, community, install date, condition, accuracy, performance, criticality, source and status.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FWaterServices%2FWaterServicesPublic%2FMapServer&source=sd`

4.16 Wastewater Pipes

4.16.1 Wastewater Pipes (Buller)

A wastewater pipe is an underground conduit designed to transport used water and sewage away from homes and businesses to treatment facilities. Its importance to society lies in preventing contamination, protecting public health, and maintaining sanitation standards, ensuring the safe disposal and treatment of waste while safeguarding the environment and water resources.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are asset ID, asset type, ownership, material, diameter, community, install date, condition, accuracy, performance, criticality, owner, source and status.

Source

Provider:	West Coast Regional Council
Date:	17/03/2024
License:	Creative Commons Attribution 4.0 International License
Source:	`https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FWaterServices%2FSewerServicesPublic%2FMapServer&source=sd`

4.17 Police Stations

4.17.1 Police Stations (New Zealand)

A police station is a facility operated by a law enforcement agency where police officers and personnel carry out various functions related to the maintenance of public order, crime prevention, investigation, and community safety. Police stations serve as operational bases for law enforcement agencies, providing a central location for police officers to work, organise, and coordinate their activities.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the station name, address, open hours, phone number, and website.

This layer has been modified to remove duplicate features found in the dataset. In addition to this text was changed for a portion of the attributes to increase user readability and usability.

Source

Provider: Police NZ
Date: 31/01/2024
License: Creative Commons Attribution 4.0 International License
Source: `https://www.police.govt.nz/contact-us/stations`

4.18 Highly Productive Land

4.18.1 Highly Productive Land (New Zealand)

Highly productive land is the most fertile and versatile land which makes it best suited to food and fibre production. It comprises approximately 15% of New Zealand's land. The Ministry of Primary Industries has adopted the Land-Use Capability (LUC) system, which categorises land into eight classes according to its long-term capability to sustain one or more productive uses. Class 1 is the most versatile land with the fewest limitations on its use.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the area, a description of the land, the land use capability, and a description of this capability.

This layer has been filtered to only include land of LUC classes 1, 2, or 3 and a new attribute has been added to describe the specific land use capability.

Additionally, the area has been gridded into hexagons approximately 110m in diameter, to allow for better identification of the area at risk.

Source

Provider: Manaaki Whenua Landcare Research

Date: 20/12/2021

License: Creative Commons Attribution 4.0 International License

Source: `https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Land%20Capability/lri_luc_hpl`

4.19 Protected Areas

4.19.1 Protected Areas

The Protected Area Layer encompasses both land and marine areas across Aotearoa. These areas are primarily administered by the Department of Conservation Te Papa Atawhai (DOC) and are safeguarded by several key acts, including the Conservation Act, Reserves Act, National Parks Act, Marine Mammal Protection Act, and Marine Reserves Act.

The attributes displayed on the Resilience Explorer include the name, type, legislation and reserve purpose of the areas.

Click here for more information about New Zealand's protected areas.

Source

Provider: Toitū Te Whenua Land Information New Zealand

Date: 11/06/2023

License: Creative Commons Attribution 4.0 International License

Source: `https://data.linz.govt.nz/layer/53564-protected-areas/`

4.20 Rail

4.20.1 Railways (New Zealand)

A railway is a dedicated track system used for trains and trams to transport people and goods over long distances efficiently.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the railway names, track types, and vehicle types.

This layer has been filtered to only include railways marked as currently in use and each railway has been split up into 50-metre segments to allow for better identification of the railway sections at risk.

Source

Provider:	Toitū Te Whenua Land Information New Zealand
Date:	18/12/2023
License:	Creative Commons Attribution 4.0 International License
Source:	`https://data.linz.govt.nz/layer/50319-nz-railway-centrelines-topo-150k/`

4.21 Roads

4.21.1 Road Centrelines (New Zealand)

Any formed all weather route suitable for the passage of any vehicle.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham and New Zealand's offshore islands, at 1:50,000 scale.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the road name, highway number, road surface, and the number of lanes.

This layer has been filtered to only include roads marked as currently in use and each road has been split up into fifty-metre segments to allow for better identification of the road sections at risk.

Source

Provider:	Toitū Te Whenua Land Information New Zealand
Date:	13/1/2024
License:	Creative Commons Attribution 4.0 International License
Source:	`https://data.linz.govt.nz/layer/50329-nz-road-centrelines-topo-150k/`

4.22 Schools

4.22.1 Schools (New Zealand)

A school is an educational institution where students acquire knowledge, skills, and values in a structured environment. High, intermediate, and primary schools are included in this layer, however, universities, polytechs, and preschools are omitted.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the school name, type, and estimated occupancy.

This layer has been filtered from its data source to only include schools.

Source

Provider: NZ Ministry of Education
Date: 14/06/2021
License: Creative Commons Attribution 4.0 International License
Source: `https://data.linz.govt.nz/layer/105588-nz-facilities/`

4.23 State Highways

4.23.1 State Highways (New Zealand)

In New Zealand, a state highway is a major public road that is part of the national highway network and is maintained and managed by the New Zealand Transport Agency (NZTA). State highways serve as key transportation routes connecting major cities, towns, and regions across the country.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attribute displayed on the Resilience Explorer where applicable for this layer is the state highway name.

Each state highway has been split up into fifty-metre segments to allow for better identification of the road sections at risk.

Source

Provider: Waka Kotahi

Date: 20/06/2012

License: Creative Commons Attribution 4.0 International License

Source: `https://koordinates.com/layer/1331-nz-state-highway-centrelines-2012/`

4.24 Transmission Sites

4.24.1 Transmission Sites (New Zealand)

Transpower sites which include AC stations, DC Stations and Tees.

Transpower owns and operates the National Grid - the high voltage transmission network connecting areas of generation with towns and cities across New Zealand. The National Grid is made up of over 12,000 km of transmission lines and more than 170 substations. Electricity is transmitted over the grid at high voltages (up to 400,000 volts) from power stations to local lines companies and major industries. Tee connections is where a second transmission line branches from the main line.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the design voltage, line type, and a description of the line.

Source

Provider: Transpower
Date: 22/11/2023
License: Creative Commons Attribution 4.0 International License
Source: `https://data-transpower.opendata.arcgis.com/`

4.25 Transmission Stations

4.25.1 Transmission Structures (New Zealand)

All Transpower structures: Structures, towers and pole centre points.

Structures is a point dataset representing Transpower-owned high voltage transmission structures. Construction types include: poles, towers (pylons), gantries and termination points. The location of each structure is the ground centre point of the structure. The structures dataset is updated in an ad hoc manner. (Caveat - not all structures comprising New Zealand's electrical network are owned by Transpower).

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the structure type, and a description of the structure.

This layer has had the towers with duplicate locations removed to prevent legacy data from impacting the analysis.

Source

Provider: Transpower
Date: 22/11/2023
License: Creative Commons Attribution 4.0 International License
Source: `https://data-transpower.opendata.arcgis.com/`

4.26 Water Treatment Plants

4.26.1 Water Treatment Plants (Buller)

A water treatment plant is a facility that processes and purifies water from natural sources, removing impurities and contaminants to make it safe for consumption. Its importance to society is vital, as it ensures access to clean and potable water, safeguarding public health, supporting sanitation, and promoting the overall well-being of communities.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are asset ID, asset type, ownership, material, community, install date, condition, accuracy, performance, criticality, description and status.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FWaterServices%2FWaterServicesPublic%2FMapServer&source=sd`

4.27 Wastewater Treatment Plants

4.27.1 Wastewater Treatment Plants (Buller)

A wastewater treatment plant is a facility that processes and purifies used water and sewage, removing contaminants before releasing it back into the environment or recycling it for safe use. Its importance to society is paramount, as it protects public health, preserves water quality, and prevents pollution, contributing to a sustainable and healthier ecosystem for communities and ecosystems alike.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are asset ID, asset type, ownership, material, community, install date, condition, accuracy, performance, criticality, description and status.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FWaterServices%2FSewerServicesPublic%2FMapServer&source=sd`

4.28 Walking Trails

4.28.1 Walking Trails (New Zealand)

This layer contains walking and tramping tracks across Aotearoa. These tracks are defined by having the single permitted use of walking/tramping/running. Click here to see more about the walking trails.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are the trail names, region, trail condition, trail description, source dataset, maintained by, trail difficulty, dog access and mobility access.

The trails have been segmented into 50-metre lengths to enable finer resolution identification of the trail sections at risk.

Source

Provider: Herenga ā Nuku

Date: 12/12/2023

License: https://www.herengaanuku.govt.nz/privacy/terms-of-use/

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https://maps.herengaanuku.govt.nz/maps/rest/services/Tracks_Trails/MapServer&source=sd`

4.29 Wells And Bores

4.29.1 Wells and Bores (Buller)

A well or bore is a drilled or excavated hole that taps into underground water sources, providing access to groundwater. Its importance to society lies in offering a reliable and often decentralized supply of water for various purposes, including drinking, irrigation, and industrial use, especially in areas where surface water may be limited or inaccessible.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are bore number, frequency, intended bore use, parent catchment, distance to effluent, bore protection, pumping and notes.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FEnvironment%2FWaterBores%2FMapServer&source=sd`

4.30 Wetlands

4.30.1 Wetlands (Buller)

A wetland is a unique ecosystem characterized by its water-saturated conditions that support a diverse array of plant and animal life. Its importance to society encompasses functions such as water purification, flood control, habitat provision, and carbon storage, contributing to biodiversity conservation, climate regulation, and the overall health of natural environments.

The attributes displayed on the Resilience Explorer, where applicable, for this layer are wetland names and label.

Source

Provider: West Coast Regional Council

Date: 17/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.westcoast.govt.nz%2Farcgis%2Frest%2Fservices%2FResourceManagementAndPlanning%2FManagementPlansWCRC%2FMapServer&source=sd`

4.31 Jetties

4.31.1 Wharves (New Zealand)

Any structure on a waterfront, designed to make it possible for vessels to lie alongside and take or unload cargo, passengers, etc.

This layer is a component of the Topo50 map series. The Topo50 map series provides topographic mapping for the New Zealand mainland, Chatham, and New Zealand's offshore islands, at a 1:50,000 scale.

The attribute displayed on the Resilience Explorer where applicable for this layer is the jetty name.

This layer has been filtered to only include wharves marked as currently in use.

Source

Provider:	Toitū Te Whenua Land Information New Zealand
Date:	18/12/2023
License:	Creative Commons Attribution 4.0 International License
Source:	`https://data.linz.govt.nz/layer/50376-nz-wharf-centrelines-topo-150k/`

5 Tūraru | Risk Sources

Risk source data is typically categorised as chronic or acute. Chronic risks are those that are ongoing and are often associated with slow-onset hazards, such as sea level rise or temperature increase. Acute risks are those that are sudden and often associated with rapid-onset hazards, such as floods or earthquakes. Some examples that you may want to include in the Resilience Explorer are:

Chronic

- Climate/weather variability (this is being made public by the Ministry for the Environment in June-July 2024)
- Erosion
- Shallow groundwater

Acute

- Coastal flooding
- Fluvial/river flooding
- Pluvial/surface flooding
- Seismic activity and liquefaction
- Tsunami
- Volcanic activity
- Wind
- Landslides
- Wildfires

When conducting or commissioning hazard modelling, consider its use for adaptive planning. Ideally, modelled scenarios would have explicit environmental change increments (e.g., coastal flooding given 0.5m, 1m, or 2m sea-level rise). Unfortunately, many models are based on the IPCC's climate scenarios (either RCP or SSP) for an explicit year (which can still be shown and used in the Resilience Explorer). Such increments are useful for adaptive planning and monitoring, are not sensitive to the regular updates of the IPCC's scenarios, and can be mapped into those scenarios. Mapping from the scenarios to the increments is less straightforward as the environmental parameters are often not explicitly stated in the scenarios.

Nevertheless, many of the hazard datasets available are based on the IPCC's scenarios. The language around these scenarios changed with the IPCC's Sixth Assessment Report, when the Shared Socio-economic Pathways (SSP) were introduced [5]. The SSPs are a set of five scenarios that describe different future worlds, based on different assumptions about future socio-economic development. They capture the information about the radiative forcing that was presented by the RCPs, but also include information about the socio-economic development and mitigation options. Notably, all SSP scenarios include some form of carbon dioxide removal. The SSPs and how the RCPs map to them is shown in Figure 2.

This section lists the mapped hazards that are known and available to Urban Intelligence.

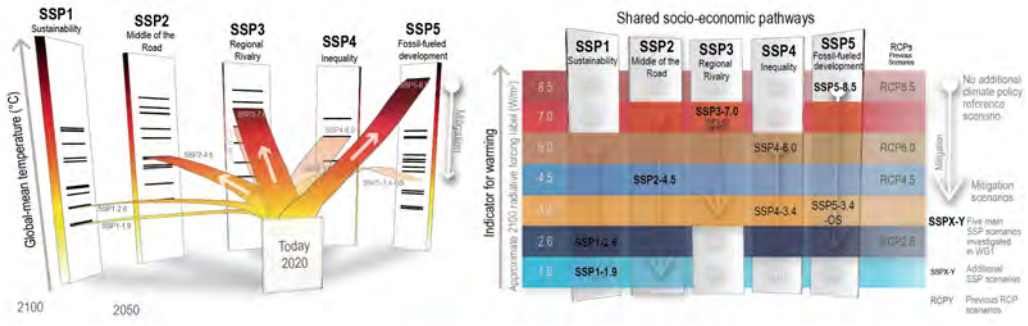


Figure 2: The SSP scenarios used by the IPCC's Sixth Assessment Report, their indicative temperature evolution and radiative forcing categorisation, and the five socio-economic storylines upon which they are built. Source: [6]

5.1 Coastal Erosion

5.1.1 Description

Coastal erosion occurs when waves eat away at the land causing the shoreline to retreat. The sand and gravel stripped from a beach or cliff can be carried away by ocean currents. They can then be deposited out at sea or on another beach, causing them to build up - a process known as accretion.

It is a natural phenomenon, but human activities and climate change can significantly accelerate the erosion process.

Erosion (and accretion) around much of the coastline of New Zealand is a natural process that has been happening for thousands of years. As the sea rises, cycles of erosion and accretion on beaches will change. Generally, the net effect of a higher sea level will increase the rate of erosion; this is due to the high-energy waves being able to reach further upshore.

5.1.2 Mapped Hazard Areas

The areas of known risk from coastal erosion for Buller are shown in red in Figure 3. The datasets available are described in the following sections.

Figure 3: Spatial coverage of coastal erosion models in Buller. The extent of the known/mapped hazard areas are shown in red and provide an indication of the spatial extent of the modelling available to date.

5.1.3 Coastal Erosion (Buller)

Coastal erosion modelling has been completed as part of NIWA's Review of West Coast Region Coastal Hazard Areas (Version 2).

The layer shows areas where erosion is likely to occur in 50 years and 100 years time (from 2020) following RCP 8.5. Sea level rise incriments can then be taken from the scenarios as 0.4 meters by 2070 and 1.2 meters by 2120. Therefore this dataset is useful for long-term planning.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

Year: 2070, 2120

Source

Modeller: NIWA
Date: 2022
License: Express permission is needed from NIWA by WCRC
Source: NIWA Client report (ttpp.nz)

5.2 Coastal Flooding

5.2.1 Description

Coastal floods occur when the sea rises above the normal high-tide level and flows onto low-lying land. Such floods range from 'nuisance events' to widespread costly inundation. Seawater may flow onto a waterfront promenade relatively frequently but only cause traffic delays and inconvenience. Much more rarely, powerful storm surges can flood homes, damage roads, and close businesses.

Coastal cities and towns have been developed over time with a stationary sea level in mind. Buildings, roads, airports, wastewater systems, and other infrastructure have all been built based on a historical understanding of the reach of the tides and occasional flooding during storms. As the sea level rises, areas of low-lying coastal land that currently flood during storms or king tides will experience more frequent and severe flooding and periods of isolation. Areas that do not experience coastal flooding currently may begin to encounter flooding.

5.2.2 Mapped Hazard Areas

The areas of known risk from coastal flooding for Buller are shown in red in Figure 4. The datasets available are described in the following sections.

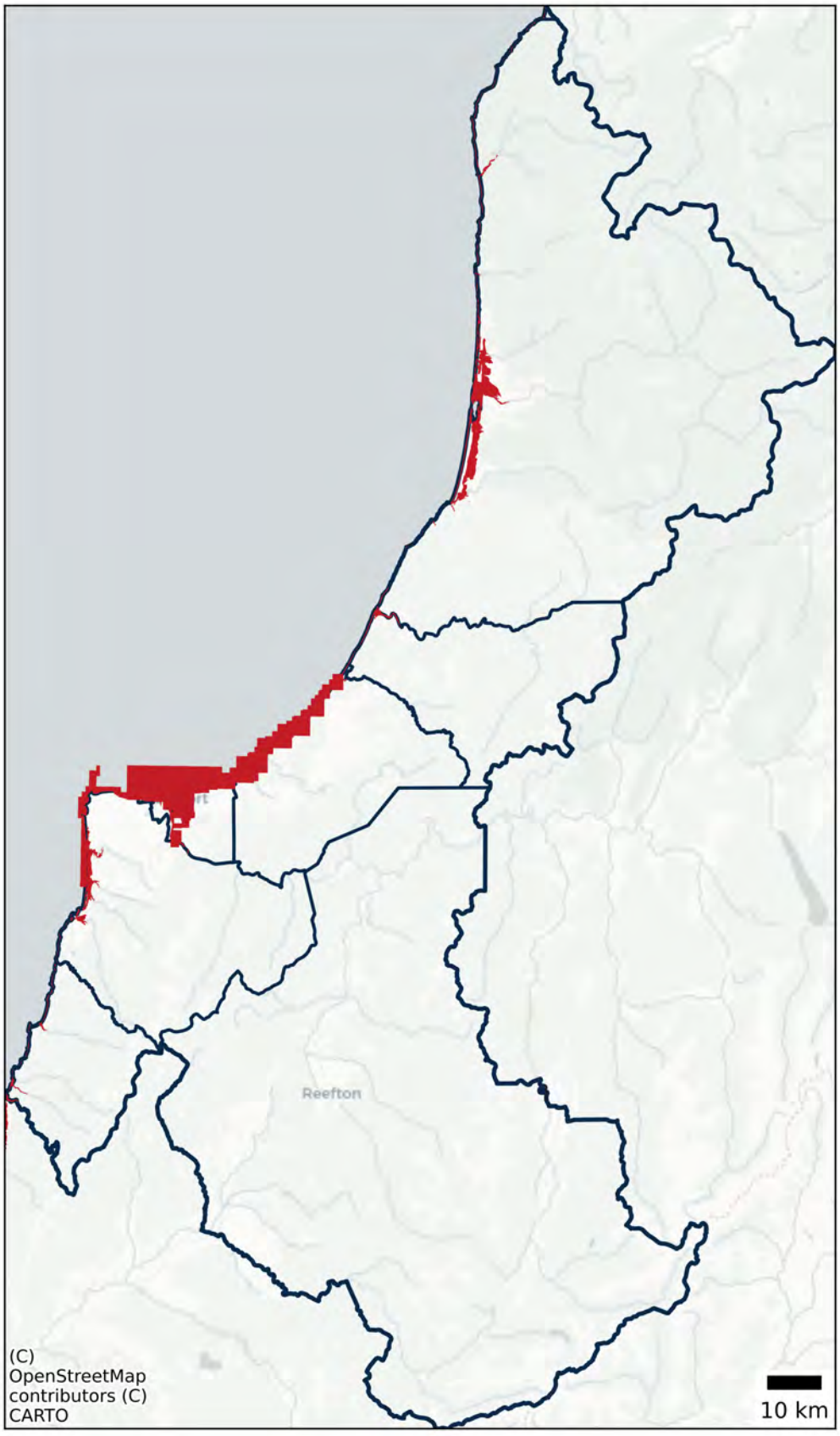


Figure 4: Spatial coverage of coastal flooding models in Buller. The extent of the known/mapped hazard areas are shown in red and provide an indication of the spatial extent of the modelling available to date.

5.2.3 Coastal Flooding (Westport)

Coastal inundation modelling has been completed for Westport.

As this layer has depth information and SLR increments up to 2m sea-level rise, this is useful for long-term planning. Further information regarding the accompanying methodology report for this hazard model needs to be sourced from West Coast Regional Council.

Suitability for long-term and climate/natural hazard adaptation planning: High

Modelled Scenarios

AEP	0.01
SLR (m)	0.0, 0.2, 0.4, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0

Source

Modeller	NIWA
Date	Confirmation needed
License	Please advise
Source	West Coast Regional Council

5.2.4 Coastal Flooding (New Zealand)

The maps and data linked from this page provide a modelled representation of New Zealand's 1% annual exceedance probability (AEP) extreme sea level flooding under current climatic sea conditions, plus relative sea level rise up to 2m above present-day mean sea level.

The data is based on analysis of sea-level measurements and numerical models and was verified against sea-level runup observations collected after large storm-tide events. Flooding was mapped using a static ('bathtub') methodology. Nationwide coverage for low-lying coastal land was achieved using a composite topographical dataset comprised of Airborne Light Detection and Ranging (LIDAR) and bias corrected Shuttle Radar Topography Mission (SRTM).

The main purpose of this dataset is to identify national and jurisdictional level flood hazard and exposure trends. Users should critically assess map accuracy and limitations to determine their appropriateness for hazard and exposure analysis at higher resolutions (e.g., property level).

The data only shows the extent of flooding and does not provide any details about the depth of the flooding.

NIWA Disclaimer: The National Institute of Water & Atmospheric Limited (NIWA) have provided maps and data on coastal flooding exposure from a large storm tide (with an estimated 1% annual exceedance probability in present climate), plus relative sea-level rise of up to 2 m above the present-day mean sea level. The data was produced at a whole of New Zealand scale and was not designed to replace more detailed regional or local data where available. The data is an estimate only and subject to uncertainty. We make no representations or warranties as to the data and shall not be liable to any person who uses or relies on the data or this ArcGIS online portal, on any ground, for any loss, damage or expense arising from such use or reliance.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

Ari:	100
SLR (m):	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200

Source

Modeller:	NIWA
Date:	2023
License:	Creative Commons Attribution-No derivatives 4.0 International License (CC BY-ND 4.0)
Source:	`https://niwa.co.nz/natural-hazards/our-services/extreme-coastal-flood-maps-for-aotearoa-new-zealand`

5.2.5 Coastal Flooding (Orowaiti-Granity)

Coastal inundation modelling has been completed for Orowaiti and Granity Bay.

As this layer has depth information and SLR increments up to 1.6m sea-level rise, this is useful for long-term planning. Further information regarding the accompanying methodology report for this hazard model needs to be sourced from West Coast Regional Council.

Suitability for long-term and climate/natural hazard adaptation planning: High

Modelled Scenarios

SLR (m):	0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6

Source

Modeller:	NIWA
Date:	Confirmation needed
License:	Please advise
Source:	West Coast Regional Council

5.2.6 Coastal Flooding (Westport)

Coastal inundation modelling has been completed for Westport and Buller River mouth.

This layer has depth information and one RCP scenario (RCP6). However, it is unclear what SLR this translates to as the year is not provided. Further information regarding the accompanying methodology report for this hazard model needs to be sourced from West Coast Regional Council.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

AEP	SLR (m)
0.010	0
0.010	1

Source

Modeller: NIWA
Date: Confirmation needed
License: Please advise
Source: West Coast Regional Council

5.3 Fluvial Flooding

5.3.1 Description

River flooding generally happens during heavy rain, when rivers overflow their banks onto the floodplain. A floodplain is a flat section next to a river and can flood quite regularly. Normal rainfall soaks into the soil, is taken up by trees and plants, and runs off the land to form our streams and rivers. Floods happen when there is too much water and the run-off can't be contained by the river's banks and floodbanks. River flooding can also result from the melting of ice and glaciers, flash floods, dam failures, or the release of water from reservoirs.

5.3.2 Mapped Hazard Areas

The areas of known risk from fluvial flooding for Buller are shown in red in Figure 5. The datasets available are described in the following sections.

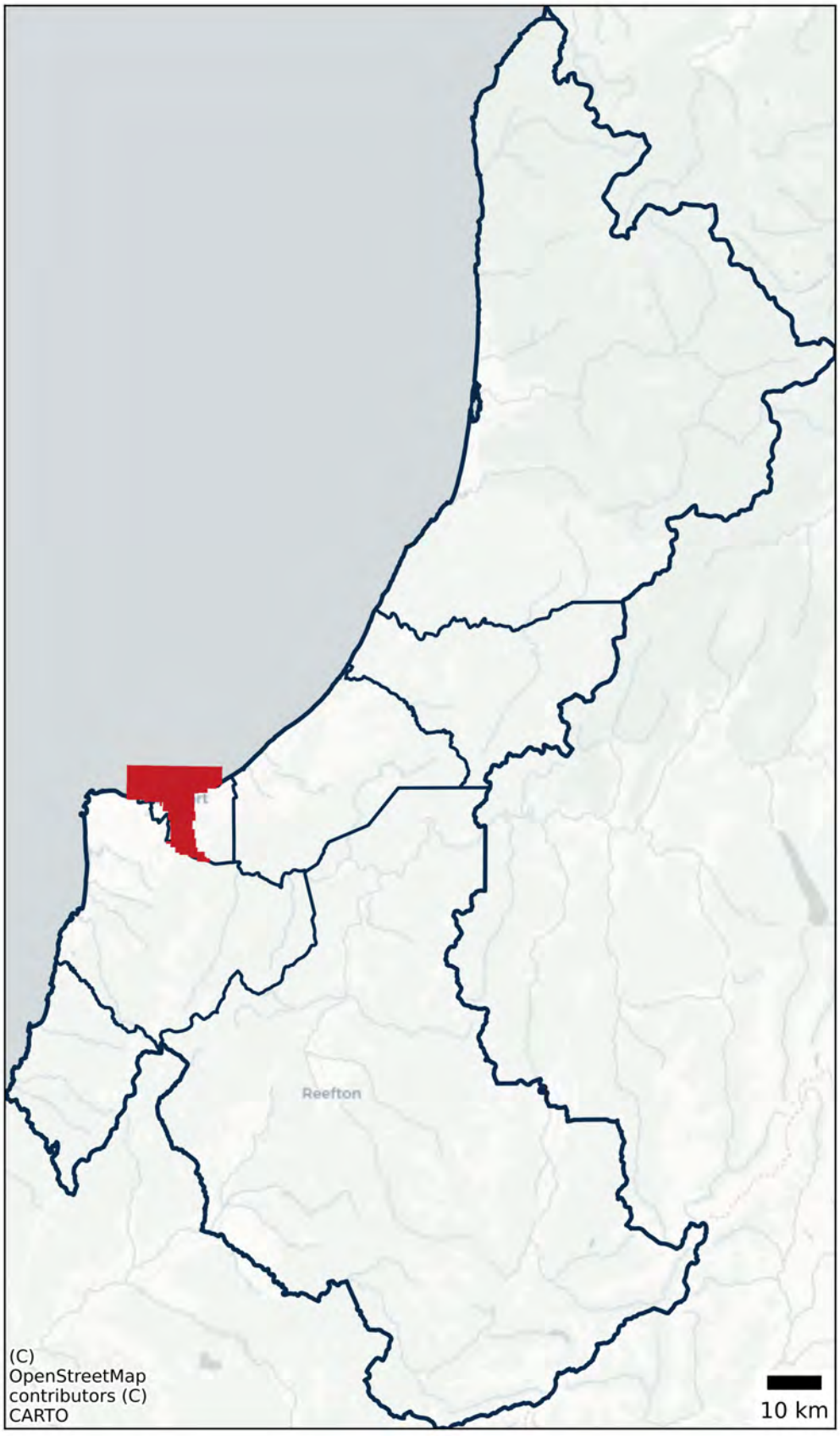


Figure 5: Spatial coverage of fluvial flooding models in Buller. The extent of the known/mapped hazard areas are shown in red and provide an indication of the spatial extent of the modelling available to date.

5.3.3 Fluvial Flooding (Buller River)

Fluvial (river) flooding for the Buller River from the coast to the inland extent of the Lower Buller Gorge Scenic Reserve.

This hazard model has flood depth information, multiple even return periods, and multiple RCP scenarios. These RCP scenarios can be translated into sea-level rise so that it can be more effectivly used for adaptive planning.

The first 10cm of flood depth was removed from the hazard models (to remove minor effects and address aspects of modelling uncertainties).

Suitability for long-term and climate/natural hazard adaptation planning: High

Modelled Scenarios

AEP: 0.01, 0.02, 0.05

RCP: 4.5, 6.0, 8.5, 2024

Block: 5

Source

Modeller: LandRiverSea Consulting

Date: 2022

License: Please advise

Source: `https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Services/Special%20Rating%20Districts/Westport/Westport%20Options%20Report_FINAL.pdf`

5.4 Landslide

5.4.1 Description

Landslides are the downward movement of rock, soil, and debris on a slope. Landslides can occur in various forms, including rockfalls, debris flows, mudslides, and earthflows. Landslides are common in Aotearoa New Zealand and they can range in size from small, localised movements of material to large, catastrophic events that cover vast areas.

5.4.2 Mapped Hazard Areas

The areas of known risk from landslide for Buller are shown in red in Figure 6. The datasets available are described in the following sections.

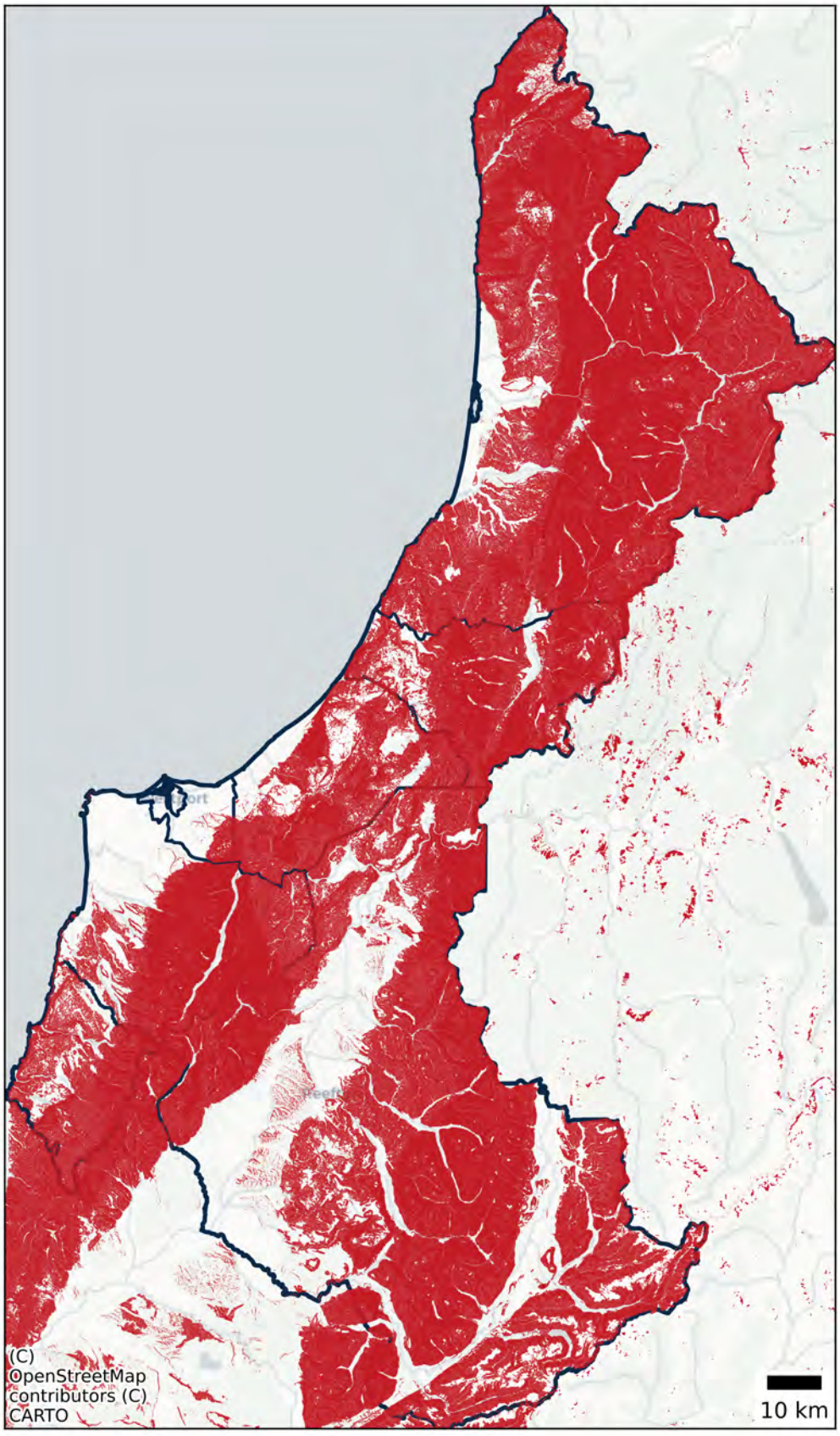


Figure 6: Spatial coverage of landslide models in Buller. The extent of the known/mapped hazard areas are shown in red and provide an indication of the spatial extent of the modelling available to date.

5.4.3 Highly erodible land (New Zealand)

Manaaki Whenua Landcare Research has modelled erodible land across the country. The data identified five classes of land at risk of erosion:

- High landslide risk (delivery to stream);
- High landslide risk (non-delivery to stream);
- Moderate earthflow risk;
- Severe earthflow risk;
- Gully risk.

For this purpose, we show classes one and two. Landslide erosion is the shallow (approximately 1m) and sudden failure of soil slopes during storm rainfall. On the otherhand, earthflow erosion is the slow downward movement (approx. 1m/year) of slopes and only occurs in the North Island.

This data is useful for high-level land-use decisions and soil conservation management. Ideal models for adaptation planning would consider change in rainfall patterns.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

Year: 2012

Source

Modeller: Manaaki Whenua – Landcare Research

Date: 2012

License: Creative Commons Attribution 4.0 International License

Source: `https://www.stats.govt.nz/indicators/highly-erodible-land`

5.4.4 Landslide Susceptibility (West Coast)

This model and associated study identifies areas that are susceptible to rainfall triggered landslides. In this map, landslide susceptibility is categorised into five categories:

- Very low: Effectively free of landslide hazard
- Low: Landslides occur infrequently and will be small and easily managed
- Moderate: Landslides occur infrequently, but on rare occasions may be large enough to cause property damage
- High: Damaging landslides occur occasionally and smaller landslides may be frequent
- Very High: Damaging landslides are common

On the Resilience Explorer, the layer is filtered to show moderate to very high susceptibility from landslides.

Note that this map does not consider temporal characteristics, return periods, or changing environmental conditions in the future. Therefore, it's suitability for long-term planning is low. Additionally, it is a regional scale study and so there are limitations for detailed or site-specific risk assessments and it does not consider earthquake-induced landslides.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

Year: 2012

Source

Modeller: Kevin England
Date: 2011
License: Please advise
Source: TBD

5.5 Liquefaction

5.5.1 Description

Liquefaction refers to a phenomenon where saturated, loose, sandy soils behave like a liquid during the shaking of an earthquake. Liquefaction occurs when seismic shaking increases the water pressure in the ground, causing saturated soil to behave like a fluid. This results in material moving up towards the ground surface in a liquid form. Liquefaction can cause major damage as buildings, roads, and vehicles can sink into the liquefied soil, causing damage to the building foundations and structure.

5.5.2 Mapped Hazard Areas

The areas of known risk from liquefaction for Buller are shown in red in Figure 7. The datasets available are described in the following sections.

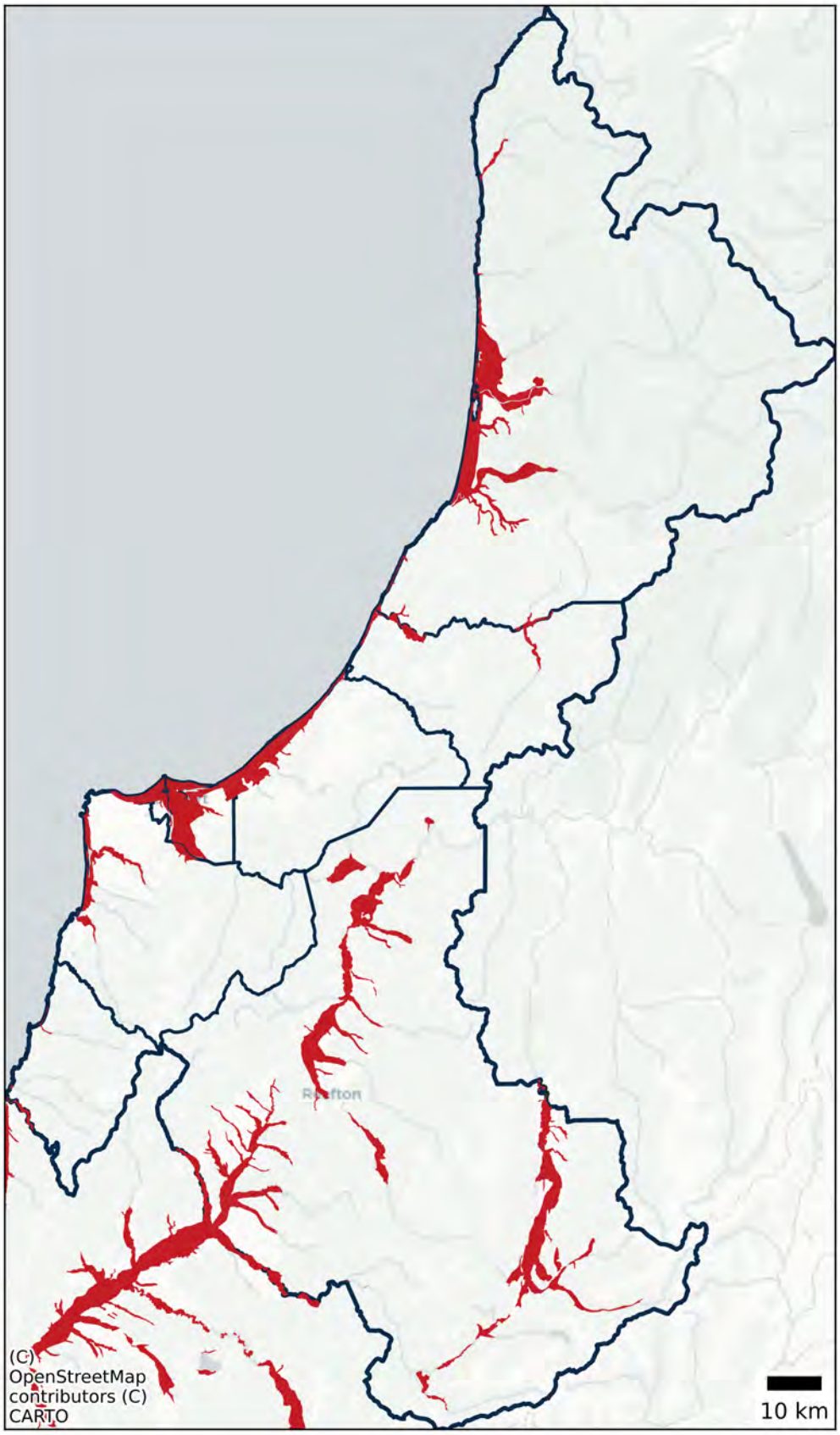


Figure 7: Spatial coverage of liquefaction models in Buller. The extent of the known/mapped hazard areas are shown in red and provide an indication of the spatial extent of the modelling available to date.

5.5.3 Liquefaction (West Coast)

Liquefaction susceptibility in the West Coast was assessed in accordance with the Ministry of Business, Innovation and Employment (MBIE) 2017 guidance for planning and building on liquefaction-rone land. The assessment was completed by Beca in 2021 and identifies areas where liquefaction damage is possible' and whereliquefaction damage is unlikely' and/or has a very low liquefaction vulnerability'. Areas where liquefaction is possible has been further categorised into areas with-high liquefaction susceptibility' as part of work for the West Coast Civil Defense and Emergency Management Group.

The layer shown includes areas where liquefaction damage is possible and where there is high susceptibility. These categorisations mean that further liquefaction assessment is needed as part of planning and consenting processes for any intensification or land use or buildings in the area.

For long term planning purposes, this data does not include groundwater level change (associated with sea-level and precipitation change). Additionally, it is not associated with a return period. Without these long-term considerations, its suitability is low.

Suitability for long-term and climate/natural hazard adaptation planning: Low

Modelled Scenarios

SLR (m): 0

Source

Modeller: Beca

Date: 2021

License: Please advise

Source: https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/West%20Coast/2021_BECA_WC%20Regional%20Liquefaction%20Assessment.pdf

6 Contextual Information

Understanding contextual information is important for effective adaptation planning. These factors provide insights into the vulnerabilities, resource needs, and capacities of the community. By considering these factors, planners can identify vulnerable populations and better evaluate interventions within their wider context, enabling more holistic and effective resilience planning tailored to the specific needs and challenges of each community. Contextual layers do not affect the exposure of the consequence of the previously described layers, but they support the interpretation of the results and the development of adaptation strategies.

Examples of contextual information that may be relevant to include in the Resilience Explorer are:

Demographics

- Population density
- Age distribution
- Deprivation

Economic

- Employment
- Income distribution
- Industry

Environmental

- Vertical land movement
- Soil type
- Vegetation
- Historic land use

Social

- Education
- Home ownership
- Vehicle ownership

6.1 2018 Census

6.1.1 Description

The New Zealand Census 2018 Statistical Area 1 dataset provides information about population distribution and characteristics across different regions in New Zealand. This dataset has been modified to include:

- Statistical Area 1 code
- Urban Rural name in each SA1 code
- Usual Resident Population: total count of people who usually reside in each SA1
- 2018 NZDeprivation index: relative deprivation levels (range from 1 to 10) in each SA1
- Percentage of age over 65: Proportion of the population aged 65 years and older
- Percentage of education of level 3: Share of residents with a Level 3 certificate or equivalent qualification
- Percentage of Ethnicity Groups: Distribution of European, Maori, Pacific, Asian, and other ethnicities
- Percentage of Households with No Vehicle Access: Proportion of households without access to a vehicle
- Percentage of Rental Households: Share of households that rent their accommodation

6.1.2 Source

Provider: Stats NZ Tatauranga Aotearoa

Date: 11/08/2022

License: Public

Source: https://www.arcgis.com/apps/mapviewer/index.html?url=https://services.arcgis.com/XTtANUDT8Va4DLwI/ArcGIS/rest/services/New_Zealand_Census_2018_and_deprivation_index_Statistical_Area_1/FeatureServer&source=sd

6.2 Employment

6.2.1 Description

Stats NZ provides statistics about businesses and employment at the SA1 level. Business demography statistics provide an annual snapshot in February of each year (in this instance 2022), of the structure and characteristics of New Zealand businesses. Statistics produced include counts of enterprises and geographic units by industry, region, institutional sector, business type, degree of overseas ownership, enterprise births, enterprise deaths, survival rate of enterprises and employment levels. In this case, we report the number of business and employees per ANZSIC division for each SA1. ANZSIC codes are reference numbers that represent the hierarchical levels of occupations in Australia and New Zealand.

This information helps to understand the economic impact of events.

Additionally, Infometrics provides further details, including the proportion of the region's 2023 GDP by ANZSIC Divsion:

- Owner-Occupied Property Operation: 10.7%
- Manufacturing: 10%
- Professional, Scientific and Technical Services: 8%
- Health Care and Social Assistance: 8%
- Construction: 7.9%
- Unallocated: 7.6%
- Rental, Hiring and Real Estate Services: 7.3%
- Agriculture, Forestry and Fishing: 6.8%
- Retail Trade: 6.4%
- All others: 27.3%

6.2.2 Source

Provider: Stats NZ Tatauranga Aotearoa

Date: 01/02/2023

License: Creative Commons Attribution 4.0 International License

Source: https://datainfoplus.stats.govt.nz/Item/nz.govt.stats/bdb02aa2-866e-418f-83e8-342234867a0f

6.3 NZ Deprivation Index

6.3.1 Description

The NZDep is an area-based measure of socioeconomic deprivation in Aotearoa New Zealand and is provided by EHINZ. It measures the level of deprivation for people in each small area. It is based on nine Census variables.

NZDep is displayed as deciles. Each NZDep decile contains about 10% of small areas in New Zealand.

- Decile 1 represents areas with the least deprived scores
- Decile 10 represents areas with the most deprived scores

It is available at the meshblock, SA1, and SA2 level, although we show the meshblock level (the finest available resolution).

It is important to note that:

- NZDep estimates relative socioeconomic deprivation for areas, not people.
- NZDep should not be used to look at changes in absolute deprivation over time as 10% of areas will always have the most deprived scores.
- The indicators used for each NZDep may change from Census to Census.

6.3.2 Source

Provider: EHINZ

Date: 16/03/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.ehinz.ac.nz/indicators/population-vulnerability/socioeconomic-deprivation-profile/#new-zealand-index-of-deprivation-nzdep`

6.4 Pre-settlement wetlands

6.4.1 Description

Freshwater wetlands in New Zealand include permanently or intermittently wet areas, shallow water or land/water margins that support a natural community of plants and animals adapted to living in wet conditions. This layer was mapped at 1:50,000 to a minimum size of 0.5ha.

Click here for more information about pre-settlement wetlands.

6.4.2 Source

Provider: Minstry for the Environment

Date: 24/04/2017

License: Public

Source: `https://data.mfe.govt.nz/layer/52677-prediction-of-wetlands-before-humans-arrived/`

6.5 Vertical Land Movement

6.5.1 Description

In New Zealand some areas of the coastline are shifting vertically upwards (uplift) and some parts are sinking (subsiding) on a daily, annual and long-term basis, irrespective of earthquakes. This is known as vertical land movement and has a direct impact on local sea level along coastlines.

The NZ SeaRise: Te Tai Pari O Aotearoa programme is mapping every 2km of the coast of Aotearoa. This data and more information can be found on their online tool.

This information provides important context for understanding the other influences of sea-level change. As the NZ SeaRise project has shown, the impacts from relative sea-level rise will be experienced significantly earlier in some areas.

6.5.2 Source

Provider: NZ SeaRise: Te Tai Pari O Aotearoa

Date: 16/02/2024

License: Creative Commons Attribution 4.0 International License

Source: `https://www.searise.nz/`

6.6 Waterways

6.6.1 Description

This shows the LINZ New Zealand River Centrelines layer at 1:50k resolution. This layer is a component of the Topo50 map series and shows any natural, flowing body of water emptying into an ocean, lake or other body of water and usually fed along it's course by converging tributaries.

6.6.2 Source

Provider:	Toitū Te Whenua Land Information New Zealand
Date:	16/03/2024
License:	Public
Source:	`https://data.linz.govt.nz/layer/50327-nz-river-centrelines-topo-150k/`

7 Providing Data

We accept data in a range of formats. If possible, we prefer to use REST (including ArcGIS) and API services, but are also happy to download data, receive it by email (or hard drive), or have it uploaded into our Google Drive folder (link available on request). To arrange, please contact Anna Scheirlinck (anna.scheirlinck@urbanintelligence.co.nz).

Data creation is beyond the scope of the standard Resilience Explorer license, as typically Urban Intelligence does not do hazard modelling. Instead, Urban Intelligence can provide guidance on the data and scenarios that may be required to ensure that it will be useful for adaptation planning.

When providing additional data, spatial data should be provided in shapefile, GeoJSON, or raster formats. Alternatively, CSV files that include coordinates (latitude and longitude) can be used. This data needs to include

- The date or year the data was created
- A description of the data
- The scenarios (input parameters) modelled and/or attributes provided
- The provider/modeller
- The data license or permissions
- The associated technical report, including meta data and any assumptions made.

Please contact us if you have any questions or need further information.

Tohutoro | References

[1] Intergovernmental Panel on Climate Change (IPCC). *IPCC AR5 Report on Climate Change*. Tech. rep. Geneva: IPCC, 2014.

[2] SRA. *Society of Risk Analysis Glossary*. Tech. rep. 2022. DOI: https://www.sra.org/resources.

[3] *Coastal hazards and climate change guidance*. Tech. rep. Wellingon: Ministry for the Environment, 2024.

[4] M Garschagen et al. "The consideration of future risk trends in national adaptation planning: Conceptual gaps and empirical lessons". In: *Climate Risk Management* 34 (Jan. 2021), p. 100357. ISSN: 2212-0963. DOI: 10.1016/j.crm.2021.100357.

[5] IPCC. *Climate Change 2022 - Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Ed. by H. O. Pörtner et al. Cambridge University Press, 2023. ISBN: 9781009325844. DOI: 10.1017/9781009325844.

[6] IPCC. "Summary for Policymakers". In: *Climate Change 2021 – The Physical Science Basis*. Ed. by V Masson-Delmotte et al. Cambridge University Press, 2021, pp. 3–32. ISBN: 9781009157896. DOI: 10.1017/9781009157896.001.

[7] S Awatere et al. *He huringa āhuarangi, he huringa ao: A changing climate, a changing world*. Tech. rep. 2021.

A Āpitihanga | Appendices

A.1 Example Use Case: Adaptation Planning

As an example of the type of data that can be included in the Resilience Explorer and how it is used is Climate Adaptation Planning. The general process for adaptation is outlined in the Ministry for the Environment's ten-step adaptation cycle (Figure 8). Step four of this process is to assess the risks. The process incorporates the range of hazard and risk source information available, and seeks to evaluate the importance and priority of these hazards and their impacts. The purpose is to enable priority areas to be identified, gaps in knowledge to be identified and evaluated for their importance, and interventions to be evaluated. Once the quantitative assessment is completed, the data can be combined with qualitative information to evaluate the risk to the things that you value (what we call interests).

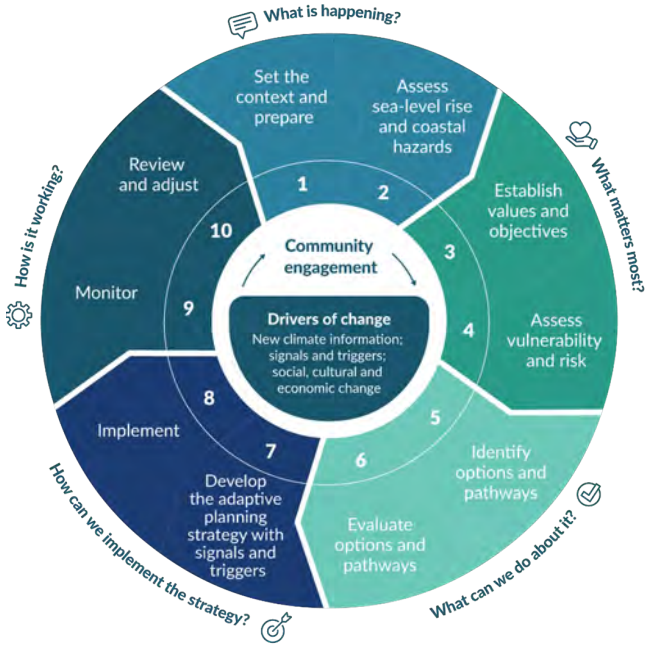


Figure 8: The Ministry for the Environment's ten-step adaptation cycle from the Coastal Hazards Guidance [3].

Risk is conceptualised as the outcomes and their associated uncertainties, with respect to something that humans value [2]. Therefore, to assess risk and prioritise adaptation, a key step is to identify what is valued. The National Climate Change Risk Assessment (NCCRA) identifies subdomains which represent the key areas to which risk was assessed. These subdomains (values) are described as 'interests' in the guidance for Te Ao Māori climate adaptation, produced by Ngā Pae o te Māramatanga and Manaaki Whenua [7], and we adopt this terminology. For example, an interest might be 'Indigenous ecosystems and organisms', 'Social cohesion and community wellbeing', or the 'Tourism sector'. These interests are categorised into 'value domains' and these represent groups of values, assets, and systems that may be impacted by climate change. The interests and value domains are used to guide the assessment and identify relevant factors to consider when evaluating risk. The domains used in the NCCRA are human, natural environment, built environment, economic, and governance [3]. In contrast, the guidance for Te Ao Māori climate adaptation focused on four key domains: He Kura Taiao (the natural environment), Whakatipu Rawa (Māori Enterprise), He Oranga Tāngata (healthy people), and Ahurea Māori, Tikanga Māori (Māori culture and practice) [7].

To assess the risk to these interests, various elements and contextual information is relevant to each

interest. For example, to understand the risk to indigenous ecosystems, we need to understand not only where the ecosystems are and what environmental change or risk sources they might experience, but also the presence and vulnerability of landfills or potential contaminants. There is no need for an exhaustive or unchangeable list, but rather these interests can provide indicative guidance on what information you might want included in the Resilience Explorer. An example of some of the interests and value domains that might be relevant to your community are:

Human

- *Risk to social cohesion and community wellbeing* includes cemeteries, demographics of people exposed, and access to amenities, parks, and reserves.
- *Risk to physical health from exposure to hazards* involves the demographics of people exposed, potable water network, and wastewater network.
- *Risk of exacerbating and creating inequalities* covers demographics of people exposed and displaced, percentage of rental population exposed.
- *Risk to heritage and culturally significant sites* involves heritage buildings, marae, urupā, pā, and sites of cultural and archaeological significance.
- *Risk to accessing medical care and emergency services* includes exposure to and isolation from health care facilities and emergency services.
- *Risk to accessing education* involves schools/early childhood education, isolation from schools, and access to basic services.
- *Risk to accessing community services* includes community facilities and isolation from these services.
- *Risk to accessing food/resources* involves supermarkets, isolation from supermarkets, access to power, and supermarket supply chains.
- *Risk to recreation* includes access to recreational sites, facilities, huts, and tracks.
- *Risk to communications* involves telecommunications infrastructure and residential and commercial internet access.

Natural Environment

- *Risk to indigenous terrestrial, marine, and freshwater ecosystems and organisms* involves understanding sites of ecological significance, contaminated sites, landfills, and pest species.
- *Risk to exotic ecosystems and species* covers similar elements as indigenous ecosystems.
- *Risk to parks and blue-green infrastructure* includes cemeteries, parks, reserves, sports fields, community planting, and wetlands.
- *Risk to endangered species* involves sites of native and endemic species, and sites with pest species.
- *Risk to natural structures, formations, and/or regimes* (e.g., river channels) involves river formations and structures, engineered structures, and riverbeds.
- *Risk to mahinga kai and cultural resources* includes access to sites, and mahinga kai sites.

Built Environment

- *Risk to potable water supply* includes water supply network pipes, pumps, stations, catchment, and extraction.
- *Risk to buildings* (residential, commercial, industrial, and other structures) includes marine facilities, commercial and industrial properties, jetties, residential and community buildings, tourism buildings, hospitals, emergency operating centres, and farm processing and agriculture sites.
- *Risk to landfills and contaminated sites* includes contaminated sites, landfills, factories, roads, active and inactive storage tanks, and transfer stations.

- *Risk to wastewater and stormwater* includes coastal and riverine flooding defences, septic tanks, stormwater network pipes and pumps, and wastewater network pipes, pumps, stations, and treatment plants.
- *Risk to transportation* includes bridges, cycleways, public roads, railways, service stations, state highways, walkways/trails, airports, and ports.
- *Risk to electricity, energy, and communications* includes electricity and gas infrastructure, mobile towers, service stations, and storage tanks.

Economic

- *Risk of insufficient local government income/excess expenditure* includes rating base, money spent on emergency and recovery operations, insurance costs or coverage, and central government support.
- *Risk of overall financial system* (e.g., banks) instability includes financial institutions' performance and credit/fund availability.
- *Risk to land-based primary sector viability* includes operating profit per hectare, hectares of productive land, months of production, regional accessibility, and skilled workforce availability.
- *Risk to tourism sector viability* includes accessibility of key attractions, cycleways, tracks, number of hospitality venues and tourism operators, and labour availability.
- *Risk to fisheries sector viability* includes sites of marine ecological significance, fish stocks, wharf and port functionality, labour availability, and regional accessibility.
- *Risk to the insurability of assets* includes accessibility to insurance and equity of access to insurance.
- *Risk to productivity due to supply chain and distribution system disruptions* includes roads, bridges, warehouses, ports, and airports.
- *Risk to exacerbating economic inequality* includes income disparity, deprivation, and economic diversity.
- *Risk to new industries* (in particular technology) includes internet access, electricity infrastructure, liveability/lifestyle, and reputation.

Governance

- *Risk of maladaptation due to processes not accounting for uncertainty and long-term change.*
- *Risk that climate adaptation is not supported by institutions, processes, funding mechanisms.*
- *Risk of increased litigation.*
- *Risk of breaching Treaty obligations.*
- *Risk of maladaptation due to knowledge and capacity gaps.*
- *Risk that the Emergency Management system will not adequately respond.*
- *Risk of doing nothing as elected members cannot agree or are not engaged in climate-hazard challenges.*
- *Risk of failure to follow democratic process due to frequency and scale of impacts.*
- *Risk of path dependency/sunk cost fallacy.*
- *Risk of loss of community trust and buy-in.*

This list is not strict or restrictive; its purpose is to guide the assessment and identify relevant factors to consider when evaluating risk to the different interests. Additionally some of these (notably Governance domain related) may be less relevant for a spatial assessment, but are included for completeness.

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URBAN INTELLIGENCE

Buller District Council

Climate Change Risk Assessment and Adaptation Planning:

STAKEHOLDER AND COMMUNITY ENGAGEMENT STRATEGY

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BULLER DISTRICT COUNCIL
Te Kaunihera O Kawatiri

Introduction

Climate change and climate-related hazards are already impacting the Buller District. As a result, the Buller District Council has begun a climate change adaptation planning programme as part of its Long-Term Plan (2021-2031). The council has adopted a research-based approach, developing a climate change action plan for Buller, informed by a risk assessment based on The Ministry for the Environment's Local Climate Change Risk Assessment Guidelines, in partnership with mana whenua Ngāti Waewae.

This document sets out the indicative approach to engagement with stakeholders and the community through the first risk assessment and adaptation planning process. It is envisaged that an ongoing programme of engagement will be incorporated into the Council LTP processes after this first risk assessment and adaptation planning cycle.

Broadly speaking, engagement addresses how the Council will collaborate with stakeholders and local communities to develop project outcomes. This overall engagement strategy will be supported by an operational plan setting out specific communications activities and timelines.

Background

Climate change in Buller

Climate change presents both risks and opportunities for the Buller District. The present-day impacts of a changing climate and hazardscape are already being noticed within the built and natural environments, and the cascading impacts are being felt in the communities, businesses, and institutions. As the climate continues to change, these impacts will likely be exacerbated. Understanding, managing, and taking advantage of these challenges and opportunities is the objective of a risk assessment and adaptation programme.

Extreme weather is one of the most salient consequences of climate change and has already been experienced in the Buller District. The extreme flood events of July 2021 and February 2022 – estimated by the Buller District Council to cost >$100m NZD and $20-45m NZD, respectively – are indications of what a changing climate will bring. Based on current warming alone, climate scientists estimate that at least 30% of recent worldwide weather-related economic losses are attributable to human-driven climate change.[1]

Another threat from climate change is sea level rise. While all of coastal New Zealand is exposed to coastal hazards, the Buller District has one of the highest levels of exposure. Figure 1 shows the coastal flood risk based on today's sea level, based on coastal flooding alone (excluding planned defensive infrastructure). In addition to threats from the flood waters, these and other at-risk areas may be subject to insurance retreat or rising premiums. As these risks, among others, increase with climate change, the district must begin to adapt.

1 "Climate change attribution and the economic costs of extreme weather events: a study on damages from extreme rainfall and drought." Deep South Challenge (2020).

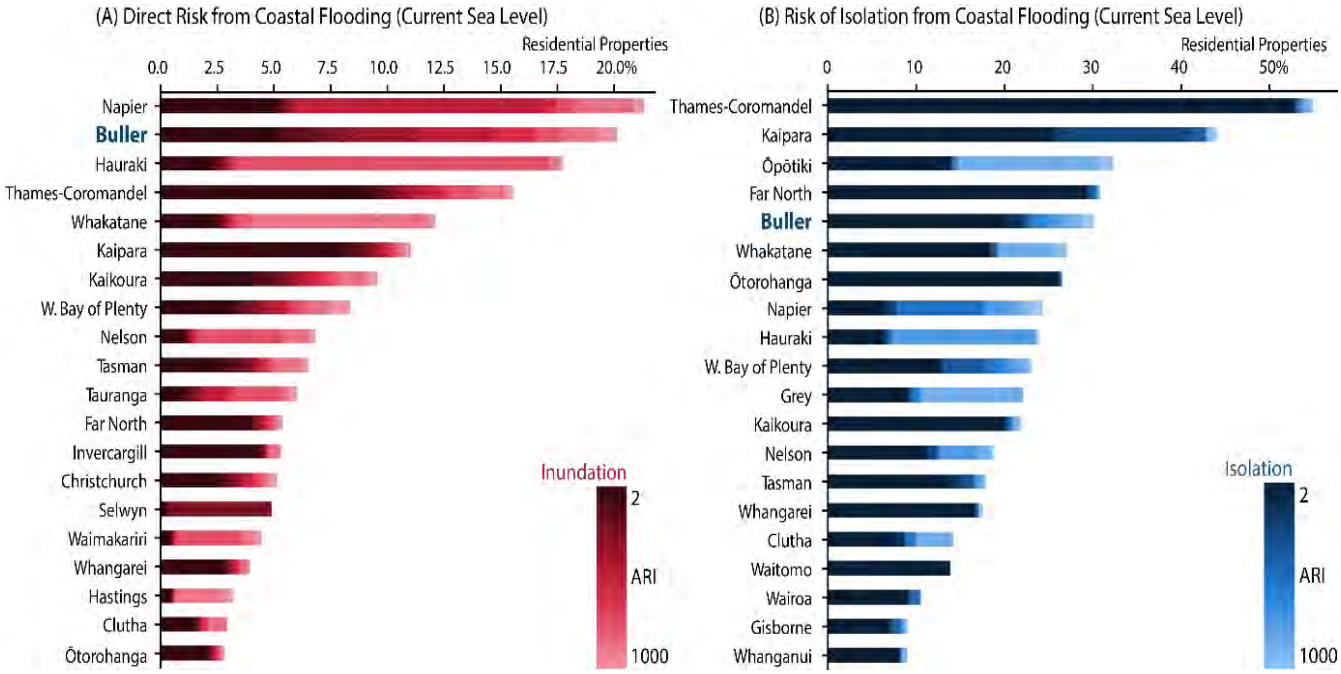

Figure 1. Current coastal flood risk (based on percentage of residential properties affected) in the twenty most exposed territorial authorities in New Zealand. This shows the risk from coastal flooding with annual return intervals (ARIs) between 2-1000 years for current sea level. (A) Inundation occurs when a building is exposed at any depth. (B) Isolation occurs when the roads are flooded such that cars cannot pass. Although this may be temporary isolation, long-term road damage is possible, risking extended isolation. (Source: Logan et al. 2022 based on coastal flood maps from NIWA (2021)).

The Buller District's vulnerability to the impacts of climate change is exacerbated by its high levels of socio-economic deprivation in conjunction with its low-density population. Together these factors mean that the people of Buller are largely unable to afford to adapt when faced with climate hazards.

National guidance regarding 'who pays' for climate adaptation is signalled to be available at the end of 2023. It is likely that risk and cost will be shared across society, including asset or property owners, insurance companies, banks, local government, and central government[2]. Until the details of a shared-cost model are announced those already exposed to climate-hazards face a very uncertain future.

The Buller community

At September 2022[3], there were 9,700 people living within the district. The median household income was $48,720 (the lowest in the country) compared to $90,840 nationally. Buller also had the lowest rate of formal adult education across Aotearoa (with almost 1/3 of adults holding no formal education), as well as one of the lowest rates of internet access nationally with over 27% of households reporting no access. At the time of the 2018 census, almost 25% of the population was older than 65 and less than 13% was aged between 15 and 29. Mana whenua, Ngāti Waewae, is the smallest hapu of Ngāi Tahu with about 6000 people who have whakapapa to the tīpuna of Te Tai o Poutini (West Coast). The hapu reaches from the Poerua River in Westland to the top of the South Island at Kahurangi Point and as far east as Arthur's Pass.

[2] Adapt and thrive: Building a climate-resilient New Zealand – Aotearoa's New Zealand's First National Adaptation Plan (2022)

[3] Dot Portal (dotlovesdata.com)

A key part of adaptation is understanding the needs and vulnerabilities of the community and empowering them, as far as possible, to be involved in the planning and decision making process. Recent context is also vitally important in informing engagement. The flooding of Westport in July 2021 as well as ongoing impacts in Northern Buller has heightened awareness of the district's climate-hazard vulnerability and created considerable uncertainty and anxiety across many parts of the community. The Flood Recovery Office and Community Hub has reported significant wellbeing effects, in particular, anxiety in relation to forecast or potential future weather events.

The Westport News has provided considerable coverage of climate change issues over the past year including the publication of various community opinions on climate-related hazards, flood recovery, current levels of exposure and risk, and issues with perceived Council incompetence. It has increasingly provided a platform for a small but vociferous group of Westport community members to 'grand-stand' and undermine the Council's efforts towards flood recovery, resilience, and longer-term adaptation planning.

Other Activities

Multiple projects are underway in relation to Buller resilience. These include Westport resilience projects: the wall, nature-based solutions and master planning for future development areas. From a community perspective, these are all part of the area of risk assessment, risk management and adaptation planning and information about the status of these will need to be incorporated into community engagement activities.

Ensuring consistent messaging across the different projects will be vital to effective engagement and achieving community confidence that they are in safe hands.

Engaging communities on climate change risk and planning

Engaging communities in climate change adaptation is crucial to developing adaptation actions that will work best on the ground in the community[4].

To ensure climate change engagement in Buller is effective, engagement will be designed by:

- Following key principles of effective engagement.
- Understanding what successful engagement looks like.
- Having a clear understanding of the Buller community context including contextual factors, challenges, and stakeholders involved.
- Using the right tools and methods for engagements based on the community context and engagement approach.

Key principles of effective engagement

The key principles[5] informing this plan and that all engagement designs need to incorporate are:

- Engage early and keep engaging.
- Engage **openly and transparently** – be honest about what we know, what we are doing, and what our constraints are.
- Engage with a genuine desire to listen and incorporate community concerns and ideas.
- Deliver on commitments made.
- Be responsive and flexible - engagement is not a one size fits all programme.
- Ensure duty of care to participants and the engagement team.
- Provide accessible, applicable (relevant to the community), and actionable information and outputs.
- Ensure one common language across all engagement.
- Provide a sense of agency/self-efficacy.
- Build strong local partnerships with Tangata Whenua, relevant agencies, and community groups.

[4] Shaw, R., Colley, M., and Connell, R. (2007) Climate Change Adaptation by Design: a Guide for Sustainable Communities. Prepared for the TCPA by Robert Shaw of the TCPA and Michelle Colley and Richenda Connell of Acclimatise, www.acclimatise.uk.com

[5] (adapted from New Zealand Government: Principles and Values for Community Engagement A guide for government agencies and policy advisors on principles and values that guide good community engagement in policy making) (http://www.dpmc.govt.nz/our-programmes/policy-project) and findings from the Let's Talk about Risk project early findings https://www.resorgs.org.nz/our-projects/risk-and-resilience-decision-making/lets-talk-about-risk/

What does successful engagement look like?

What	How we will assess/achieve
Broad engagement including diverse views and population.	Number and representation of participation, particularly amongst vulnerable or marginalised community members.
Acceptance (even if begrudgingly) of adaptation pathways and trigger points.	Feedback on engagement round 3.
Indications of community behaviour change – proactive adaptation steps by the community.	Indicators such as softening values in high-risk areas.
Maintaining optimism and positive community sentiment.	Indicators such as new business, regional migration statistics, and wellbeing reports.
Integration of engagement into decisions.	Clearly identifiable pathways outlining how engagement outputs will be used in the decision making processes.

Engagement challenges

The following table highlights some of the specific issues relating to engagement with the Buller communities on climate change and how these can be alleviated:

Risk Engagement Challenges	Addressing the challenge
Some community members have lost confidence in Council handling of climate hazards, starting project engagement 'on the back foot'.	Focus the first round of community engagement on listening and relationship building. Acceptance by project team that there will be some difficult, challenging and possibly confrontational conversations and situations during the engagement process.
Climate-change denial.	Start community engagement process using a climate-hazard' approach, as opposed to a 'climate-change' approach.
High stakes – high emotions around losses (perceived or actual).	Identify, acknowledge, and manage high emotions and provide appropriate psycho-social support. Provide communities with a sense of agency to help navigate feelings, can also empower them to deal with the risk.

Multiple projects underway relating to risk	Be well informed about all projects and keep the community informed about what we know and what we don't know – even where this increases uncertainty.
Flood events have hyper-focussed districts on flood hazards, to the detriment of other climate-hazard awareness Likewise, communities not exposed to flood hazards may believe climate-hazards do not apply to them.	Information sessions to broaden understanding of climate hazards. Use examples of other climate hazards elsewhere around the world that may have relevance to Buller in the future.
Westport community may perceive the floodwall as the 'final' solution	Information sessions to increase community awareness regarding ongoing climate risk to Westport – especially groundwater and SLR.
Some communities are highly exposed and have no plan for protection or retreat e.g., Granity.	Develop very specific engagement programmes for these highly exposed and vulnerable communities.
No one-size-fits-all approach – range of risk appetites and capacities.	Understand the range of views in the community and be clear about where communities must collectively agree on approaches vs where individuals can make independent decisions about the risks they face.
The policy vacuum at the central government level (who pays and who decides) is challenging.	Ensure the community is aware of where ownership and financial liability lie and that this is acknowledged upfront. There most likely will not be enough money to pay for everything – some things will need to be compromised.
Climate change is inherently uncertain and becomes more uncertain the longer the timeframe. This affects the nature of the hazard and the options for mitigation/reduction.	Reduce uncertainty if possible (granular scenario modelling) or enable acceptance of uncertainty to make participation more palatable.
The community does not care which organisation you are from (regional or district council).	Have a joined-up approach, if possible, with other agencies and departments. Don't pass the buck but be truthful – don't overpromise.
Climate change is a long-term phenomenon with multi-generational impacts.	Engagement across all demographics and across time is critical.

Climate change impacts can often be hard to envisage, and immediate costs often override 'invisible' benefits.	Engagement needs to balance the inherent tension in wanting to 'protect' communities' current ways of living with looking forward to opportunities for community evolution. Utilising the proximity of the latest hazard events can help bridge the gap and change awareness and appetite within the community to engage about the risk.
Understanding the science and uncertainty of climate change can often be a barrier to engagement.	While it's important that the science and uncertainty is communicated well, it shouldn't undermine the need for actions of least regret. Utilising storytelling, personal impact, being consistent with terminology, and being transparent with key assumptions and outputs (e.g. models) can help get participants through the barrier.
Understanding, prioritising and addressing 'future' hazards against more immediate challenges such as cost of living.	Emphasising the medium to long term pathways being developed in this project, rather than immediate investments.
Some community members who are currently most exposed to the effects of climate change are also those with complex psycho-social needs, high levels of vulnerability, and low levels of trust.	Engage with existing community support mechanisms to provide advice and support.
Lack of interest (or difficulty engaging due to literacy, education, internet access or vehicle access challenges) and attendance at engagement sessions impacts the diversity of views and therefore the robustness and legitimacy of the data.	Ensure multiple opportunities and mechanisms are provided for engagement as well as support mechanisms to ensure all community members are given the opportunity to engage.

Stakeholders

Climate change adaptation impacts the **entire Buller community** but is likely (at least in the short to medium term) to be most severely felt by coastal communities, especially those located on in the coastal environment on river flood plains. Climate change is a long-term phenomenon and engagement across all demographics is important to capture views on the now, and into the future.

In the initial stages of the project, key stakeholders (and partners) are:

- Elected officials
- BDC Staff, particularly Senior Leadership Team (SLT), infrastructure, community development, regulatory and emergency management
- Ngāti Waewae
- Key domain stakeholders (as invited to initial workshops)

Key decision makers	Key information and implementers	Key domain representatives
• Elected officials, including the mayor, councillors and community board • Iwi	• BDC SLT • BDC Community Services • BDC EM • WCRC • Iwi	• Iwi • Te Ha o Kawatiri • DOC • DWC • Buller Electricity • Waka Kotahi • Kiwi Rail • NEMA • MoE • MSD • Aged Concern • Flood Recovery Lead • Home Builders • Te Whatu Ora • Youth Voice Buller • Bathurst • MPI • Talleys • Westland Mineral Sands • World Farming Organisation • NBS • MfE

Key decision makers, information and implementers will be informed prior to each round of engagement with the broader community.

Key domain representatives will be engaged as part of the technical advisory group input into risk explorer, prior to the detailed explorer results being shared with the broader community.

Community Engagement approach

Overview

This project has 8 stages. The approach to community engagement will differ at each stage with a general progression along the International Association for Public Participation (IAP) public participation spectrum (Figure 2) from informing about the activity and first output – while still being open to feedback, to full decision-making collaboration. This full collaboration will require us to go beyond 'traditional' methods of the Council's engagement with its stakeholders and communities.

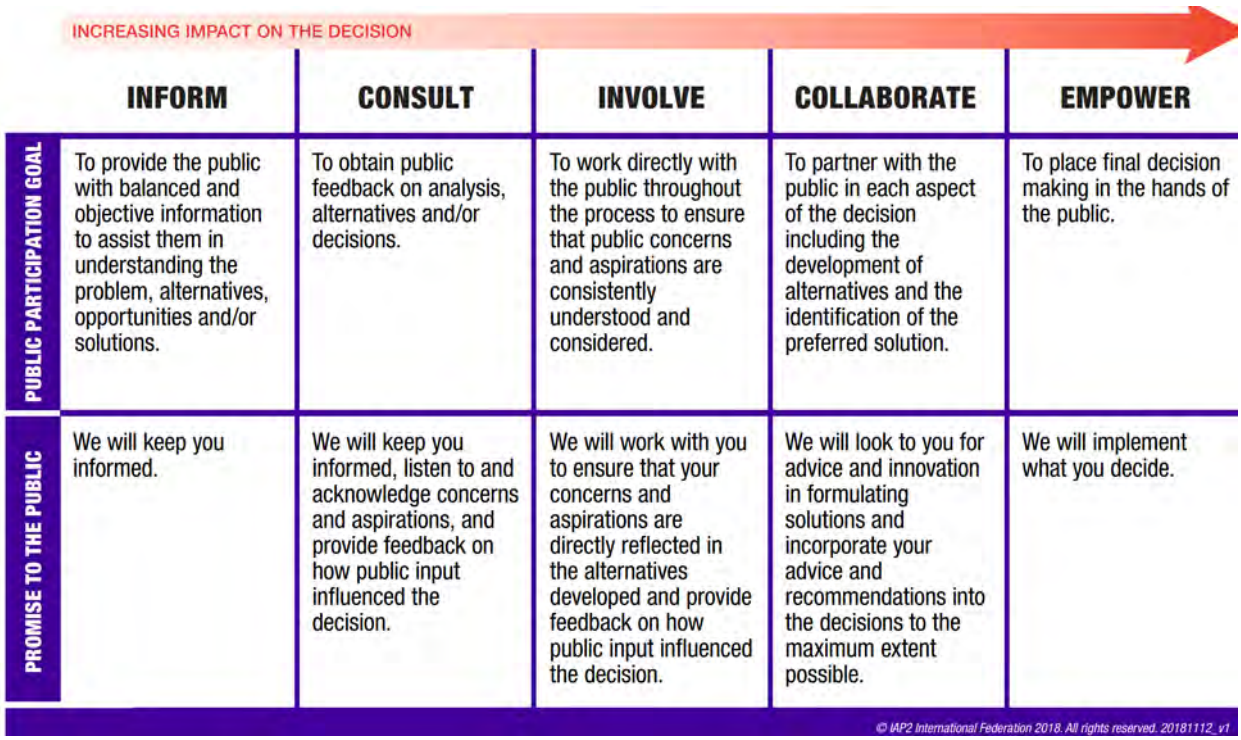

Figure 2 - IAP Public Participation Spectrum (International Association for Public Participation: https://iap2.org.au/about-us/about-iap2-australasia/)

Consecutively with the commencement of the detailed risk assessment, a broader effort needs to be launched to engage broadly with communities. As climate change impacts every citizen with interests in Buller, traditional segmentation of core stakeholder groups i.e., selecting particular representative groups, is insufficient alone to ensure full engagement.

We envisage four key stages to this broad stakeholder and community engagement.

1. Raise Awareness and Identify what is valued

- Raising awareness of the climate adaptation programme.
- Setting the scene and building the community – what do you value, what are your key climate change concerns, what do you want to see in the community in the future? Trying to get the community future focused on what really matters (focusing on what is important and not what will be lost).

2 Understand Risk

Sharing risk information from the detailed risk analysis. Providing an opportunity for questions and/or feedback on what it shows.

3 Explore Options
Exploring adaptation options and pathways – providing a platform for community ideas on adaptation options.

4Confirm 'Preferred Options'
Feedback on draft adaptation plans/pathways/decision points.

Tools/Methods

The key community engagement tools are envisaged to be:

1. **Web Portal**
   Core to enabling an ongoing conversation is the use of a council-hosted web portal (and associated activities to promote engagement with it) that enables an ongoing conversation with Stakeholders and communities. This web portal can be built in-house by the project team leading the risk analysis, Urban Intelligence, which will enable it to be linked with risk explorer. This portal is intended to be enduring across the life of this project, and beyond. This is an essential part of the toolbox to capture broad views from across the community. The intent is for a two-way flow of information between communities and the Council.

2. **Face to face community drop-ins/meetings**
   These meetings need to be designed to consider the community context factors mentioned above to ensure the right tool is being utilised for effective engagement (e.g. for in person community engagement the level of emotion may be assessed and with the aim to ensure duty of care, these sessions may be smaller and include psycho-social support to ensure participants feel open to engaging). This is particularly relevant for exposed and vulnerable communities like Granity. Support, in the form of transportation to/from the sessions, may be warranted. The presence of support services is essential i.e., Navigators, Homebuilders, Te Hau o Kawatiri, REAP etc. The provision of kai and hot drinks is also essential to assist community members through hard conversations.

3. **Collateral**
   Printed material needs to be created and distributed (including static information displays in libraries and community centres) to support the above activities. It can also be used to communicate to specific sector groups.

Each stage of engagement (described in the prior section) will require an update to the web portal content, collateral and static displays, as well as a new round of marketing.

An essential part of this process is the incorporation of community views from the prior stage into each new round of engagement, i.e., the demonstration that their voices have been heard and incorporated. As a project team, we will remain mindful that some community desires will, unfortunately, not be achievable e.g., remaining in homes in the longer term that are exposed to unacceptable levels of risk.

The engagement team

To be effective the engagement team needs to:

- Be (wherever possible) a consistent team for all face-to-face engagement.
- Ensure all team members use the same consistent language and follow the same principles of engagement and represent a 'united front'. Depending on stage and significance of meeting, the engagement team will comprise members of:
    - Project team – engagement specialists and scientists,
    - Social support staff and links to social service groups,
    - BDC staff, SLT and elected members,
    - WCRC staff and elected member (?)
- Ensure elected members are directly involved.
- Be able to access appropriate support as needed.
- Engage science communication support.

Segmentation

As engagement commences more broadly in 2023 (Stage 5 of the overall programme of work), it is envisaged that specific segmentation of communities will occur largely on a geographic basis. At this stage, consultation with elected representatives for each area will be needed to utilise their networks to profile each round of engagement as it is occurring, or to suggest specific groups within their communities where a web portal or community meeting is not fit for purpose.

The initial community segmentation is below. This grouping is iterative and will need to be reviewed considering risk assessment findings

Communities already impacted*	Communities at future high risk (to be informed by risk assessment)	All other communities
• Northern Buller • Snodgrass • Westport flood zone	• Carters Beach • South Coast • Westport non-flood zone	• Rural • Reefton • Springs Junction

**it is important that communities, where high levels of grief are already present, are engaged separately.*

To effectively manage the engagement process, the district will be divided up into engagement zones or areas according to geography, and also climate-hazard, and urgency. This will be informed by the results from the high-level risk assessment workshops. It is likely that the following areas (or similar) will be used:

- Karamea / Little Wanganui
- Mokihinui
- Seddonville
- Granity / Hector / Ngakawau (likely need to be split further to already 'at-risk' and not currently 'at-risk' segments)
- Waimangaroa
- Urban Westport – within 'wall'
- Snodgrass Road
- Carters Beach
- Westport surrounds – outside of wall and worsened by wall

- Westport surrounds – not worsened by wall
- Charleston and surrounds
- Fox River and surrounds
- Punakaiki
- Inangahua
- Reefton

It may also be worthwhile engaging separately with specific 'sectors' of the community e.g., the extractives sector, agricultural sector, marine sector, or the health sector.

Future Buller – Community Engagement Interim Report – Phase One

Authors: Alyssa Ryan, Di Rossiter, Tracy Hatton

May 2024

Project Overview

Future Buller is a joint long-term project between Buller District Council and the University of Canterbury, working in collaboration with the local community to find ways to respond to the changing climate and related events, for now, and into the future.

Future Buller's primary objective is to develop a robust climate adaptation plan for the Buller district.

Community Engagement

The Importance of Engagement

Effective and ongoing community engagement is vital for climate adaptation. Community engagement can empower the decision-making process and provide an avenue to work collectively for a shared vision of the future. This is not a one-off process but a series of ongoing conversations with communities across the next decades.

The key principles that underpin our approach to engagement design can be summarised as:

Open and Accountable:

- Engage openly and transparently – be honest about what we know, what we are doing, and what our constraints are.
- Deliver on commitments made.
- Ensure duty of care to participants and the engagement team.
- Provide accessible, applicable (relevant to the community), and actionable information and outputs.

- Ensure one common language across all engagement.

Inclusive:

- Engage early and keep engaging.
- Be responsive and flexible – engagement is not a one size fits all programme.
- Provide a sense of agency/self-efficacy.

Collaborative:

- Engage with a genuine desire to listen and incorporate community concerns and ideas.
- Build strong local partnerships with Mana Whenua, Māori, relevant agencies, and community groups.

What does successful engagement look like for Future Buller?

1. **Inclusive Engagement:** Ensuring that a wide range of community members with diverse perspectives actively participate in the project.
2. **Acceptance of Adaptation:** Achieving community acceptance, even if reluctant, of adaptation strategies and trigger points for future actions.
3. **Community Behaviour Change:** Evidencing proactive steps taken by the community to adapt to challenges and changes.
4. **Positive Community Sentiment:** Maintaining an optimistic and positive outlook within the community.
5. **Integration into Decisions:** Integrating community engagement into decision-making processes.

Phases

Our community engagement approach is based around four phases aligning with the broader project goals. This report focuses on the preliminary findings derived from Phase One.

Phase	**Phase 1**	Phase 2	Phase 3	Phase 4
Title	**What do you value?**	What is at risk?	What are our options?	Make it happen
Description	**Raise awareness of the project & identify what is valued. Setting the scene & understanding communities. Questions focused on what is important, rather than what might be lost.**	Understand climate risk & share information from the detailed risk analysis. Provide opportunities for questions & feedback.	Explore adaptation options & pathways. Provide a platform for community ideas on adaptation options.	Confirm 'Preferred Options'. Feedback on draft adaptation plans, pathways, or decision points.

Aim	**Listen and building relationships.**	Education & providing space for dialogue.	Collaborating with community & stakeholders to define options & outcomes.	Listen & gather feedback. Ensure a draft plan is submitted to council.

Phase One Activities

In November and December 2023, Future Buller hosted eight community drop-in sessions across the Buller District to start raising awareness of the project and begin a dialogue with the Buller community. Alongside these sessions, an online platform (Future Buller: Adapting to climate change (bullerdc.govt.nz) was launched to enable those unable to attend a face-to-face session to share their voice and engage with the project.

Approximately 90 participants attended the drop-in sessions:

- Karamea 17
- Ngakawau 18
- Mōhikinui 5
- Carter's Beach # 1 6
- Carter's Beach #2 20+
- Charleston 8
- Punakaiki 15
- Reefton 1

These drop-in sessions were informal with posters and opportunities to talk to the project team about the Buller District and community values. As the intent was to listen to, and build relationships, there was no formal presentation about the project, rather a brief overview was provided with scope to explain during the conversations. The online platform continues this approach with community members able to add notes through the Buller District Council website detailing what they value and like about the district.

Two of the face-to-face engagements were shared with the West Coast Regional Council as part of their roadshow about amendments to the natural hazard layers in the the Te Tai o Poutini Plan (TTPP). Given the shared messaging and cross-over in engaging and communicating with various communities, it was agreed that Future Buller would work with WCRC and share part of their space.

All face-to-face sessions were held in community facilities and to minimise expenditure, the project team attended multiple sessions on each day, and on consecutive days. This reduced the flexibility around the 'when' each workshop was held and 'for how long'. We are aware this led to some non-optimal timing for communities and will seek to better address this withing our budgetary constraints in phase two.

Phase One Findings – What do we value?

Post-it notes collected at face-to-face engagements and contributions to the online platform were analysed to reveal the following key values:

The importance of the natural environment

> *"I like the clean rivers, bush and beaches" (Charleston resident)*
>
> *"Sounds of bird life and little traffic" (Karamea resident)*

Across many contributors, the importance of the connection and ease of access to the natural environment was noted. From clean rivers, natural bush, and the sounds of the sea through to the inverse of little traffic, few people and bird rather than car noise. Also noted was the dynamic nature of the environment with on-going adaptation needed.

The importance of community

> *"A living community with local shops and a pub" (Ngakawau resident)*
>
> *"Small community that supports each other" (Charleston resident)*

Many contributors noted the sense of belonging including historical ties to place, along with community connectivity and social ties. Also, within this theme it was noted that non-conformity was OK. Reduced crime was mentioned, along with distance from larger communities being a good thing.

The importance of affordability

> *"Affordable property and people moving here from big cities" (Ngakawau resident)*
>
> *"Price of property is a big driver" (Karamea resident)*

Affordability went hand in hand with amenity of space and natural environment. Also noted under environmental was the need to maintain a local economy, and links to tourism between local amenity and the natural environment. Also noted was the need to enable community members to make good investment choices across adaptation pathways.

Concerns around this project's aims and cost

> *"The decision of BDC to spend $538,000 developing a 'climate policy' is yet another grotesque waste of ratepayer funds" (Westport resident)*
>
> *"Money should only be spent on identified problems" (Westport resident)*

A minority of community members expressed very strong concerns about the wisdom and expense of this project. Concerns included whether climate change exists, historical occurrences of expensive reports commissioned but no action taken, the focus on future rather than current problems, issues around equity and conflicts of

interest in how decisions are made in the region, and concerns about agendas to take people's land.

Summary

Phase one of community engagement was intended to generate awareness of the Future Buller project and begin the discussions about what the community values, and as a means to inform future dialogue. These four themes represent the community feedback to date. These are the things that we must ensure are retained and considered to enable successful climate change adaptation.

Community Engagement Reflections

Some aspects of the first round of engagement proved challenging with opportunities for our team to learn and adapt.

Key Issues & Challenges

- Strategic integration and prioritisation of communications and community engagement across multiple projects (with interdependencies) that enables:
    - Best use of resources, and
    - Best outcome for communities.
- Building trust across our communities following a turbulent post-disaster period.
- Best use of available budget to avoid sub-optimal outcomes e.g., events with little participation.
- Developing best practice as we work through the process i.e., there are currently no "off the shelf templates" for the delivery of climate risk assessments and adaptation plans in Aotearoa, nor for engaging with diverse communities.
- Working effectively under the challenge presented by Buller's significant climate risk profile, in the absence of central government policy for these already highly exposed and impacted communities.
- Working effectively to communicate the considerable and increasing risk to our built environments and social structures, as well as the complex indirect and cascading risk profile.
- Keeping our most vulnerable communities safe while we face the reality of no 'good' options (for some).

Lessons Learned

The first round of community engagement had some limitations and unpredicted responses that led to a refocus from hosting community members towards managing safety for the female project team in the different community spaces. The following points reflect on the lessons learned from Phase One – What do we value? They also highlight the key takeaways for subsequent iterations of community engagement as we progress through the risk and adaptation phases.

1. **If possible, avoid earlier than planned engagement:**
   Future Buller was pulled into early engagement due to TTPP engagement on coastal hazards. As there was the desire to align the interdependencies of approaches and messaging, Future Buller began the community engagement with a different plan than originally intended. To address this, Future Buller will:
   - Ensure engagement is scheduled months in advance so we can build awareness of what is happening and what potential conflicts may arise.
   - Ensure alignment between project schedules well in advance by maintaining effective communication and informing the different projects.

   However, consideration for the moving parts to coordinate means the need to remain flexible may inevitably require adaptation in our engagement planning.

2. **Community does not care which organisation we are from (BDC or WCRC or other):**
   Future Buller is associated with other projects as there is a similar message or theme of climate change, exposure, and resilience. To manage this cross-over, Future Buller will:
   - Ensure there is a joined-up approach (both Councils), and if possible, with other agencies and departments – no 'passing the buck'.
   - Align messaging, the communications strategy, and schedule as it is all one project (Buller district future resilience).

3. **We need to keep working on community awareness and participation:**
   Lower community participation impacts the diversity of views and reduces process robustness and legitimacy. We need to do better to:
   - Ensure multiple opportunities and mechanisms are provided for engagement and offered over a period of time, including the various awareness-building activities and promotion of online engagement.
   - Ensure support mechanisms (e.g., transport or online support at the library) are provided so all community members are given the opportunity to engage, whether that is at a workshop or through other methods.
   - Target already established community networks and groups and community events and use these to propagate communications.
   - Engage directly with youth forums and schools to ensure a diverse range of voices are heard.
   - Consider fewer workshops but at more convenient times for community e.g., group Karamea / Northern Buller workshop and hold in, say, Ngakawau, from 3pm – 7pm.
   - Use community connectors to connect people and help build awareness of the project, and the process. Part of this includes establishing a relationship with the various community connectors so there is a willingness to participate and support the process in some instances.

- Budget availability will impact on the number (but more importantly timing) of in-person workshops that can be held. This may affect attendance as people may be less willing or able to travel longer distances to attend workshops.

4. **There is misinformation, climate change denial, and mistrust regarding incompetence or hidden agendas of the Future Buller project:**

To address this, Future Buller will:

- Start communicating and keep communicating (even if we have nothing new to share) through proactive engagement with The Westport News, other print media and social media, to fill the gap with facts and counter misinformation with science.
- Develop and manage a wide range of community relationships which can alleviate some of the pressure and spread of negative perceptions.
- Budget availability will impact on communications resourcing but there is the option to maintain a presence through Council's website and the Future Buller engagement platform.
- Maintain our key principles of openness and transparency, noting where there is uncertainty in the science.

5. **Confrontations at events are off putting for attendees and project team members:**

- Individual community members intent on derailing the process and female project team members reported feeling unsafe.
- Consider security to manage escalations for safety of the project team and other community members attending the workshops.
- Develop mixed community engagement approaches to have a wider reach throughout the community.

Next Steps

Activities already underway to address our lessons learned include:

- Planning for greater awareness and reach for Phase Two engagement via engagement with community connectors, greater advance planning, and the use of a variety of communication channels.
- Continuing to work with aligned projects to ensure integration.

Summary

Community engagement is an iterative process that needs to be flexible and adaptive in the style and approaches used. There is no clear guide to effective inclusive engagement and there is always scope to reflect and evaluate on the next steps. Future Buller needs to establish rapport to build trust and develop lasting relationships, which will help to bring awareness to the project but also help to inform the adaptation planning and decision-making. We continue our efforts to gather data

on ‘What is valued’, to ensure that adaptation plans keep the things that matter most to Buller communities.

CCA Project Budget

SCHEDULE	AMOUNT	BIP co-funding	Package of work
Jun-23	**$130,000**	**$86,666.67**	**1**
Jul-23	**$100,000**	**$66,666.67**	**1**
Feb-24	**$111,000**	**$74,000.00**	**2**
Jul-24	**$53,000**	**$35,333.33**	**2**
Feb-25	**$53,000**	**$35,333.33**	**3**
Jul-25	**$54,000**	**$36,000.00**	**3**
Feb-26	**$54,000**	**$36,000.00**	**4**

Package of work	BDC	BIP co-funding	Total
1	$230,000	$153,333	$383,333
2	$164,000	$109,333	$273,333
3	$107,000	$71,333	$178,333
4	$54,000	$36,000	$90,000

From: BDC Lgoima
To: [redacted]
Subject: FW: Official Information Request for Climate Adaptation Expenditure Ref: OIA 068/24
Date: Thursday, 4 July 2024 2:46:54 pm
Attachments: image006.png
image007.png
image004.png
image010.png

Dear [redacted]

Further to our email dated 27 June, please find further information requested in the table below for Item 1 and Item 3, as part of our staged response. Thank you for your patience while we put this final information together to complete this LGOIMA.

Project	BDC Budget	Project status	Expenditure to date
1. **Organics waste feasibility study**	$5,000	Current	$5000 - Dextera
2. **BDC submission to Climate Change Commission**	Nil	Completed	All time donated to Council ($4,740)
3. **Future Buller – Climate Change Adaptation Project**	$555,000	Current	

Future Buller (since Jan 2022)	Dextera	Resilient Organisations	University of Canterbury	Urban Intelligence	MBC Environmental	Nook Creative	J Chandler	Aqualinc	Arahura Holdings	Direct project costs	Modelling contingencies
	91,676	102,409	64,591	144,750	3,230	528	1,252	39,600	1,530	2,067	25,092

Kind regards

Nathan Riley | Group Manager Regulatory Services
DDI 037889614 | Mobile 0273877128 | Email Nathan.Riley@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | bullerdc.govt.nz
PO Box 21 | Westport 7866

Community Driven | One Team | Future Focused | Integrity | We Care

BULLER DISTRICT COUNCIL
Te Kaunihera O Kawatiri

WEST COAST NEW ZEALAND
UNTAMED NATURAL WILDERNESS