[Intro from Mayor Marie Black]
[Intro from CEO Hamish Dobbie]

Phase one:
What is happening?

Sea level rise?

Coastal erosion?

Coastal inundation?

Rising groundwater?

HURUNUI District Council

COASTAL CONVERSATIONS
The environment is changing, how will you?

What is happening?

We live on a long narrow island with an abundant coastline. Coastal hazards are part of our reality. The map on the slide summarises national assets that are currently at risk from a changing coastline.

HDC is just starting on a project looking at the communities and assets we have that might need to adapt as the coastline changes. To kick this off we have asked Jacobs to provide some scenarios based on the most up to date science available – these look 30, 50 and 100 years into the future. This work is what we would like to share with you tonight.

But before we hear from Jacobs I would like to spend a few minutes outlining how the presentation tonight fits into the bigger project.

Phase one is about determining what is happening to the coastline now and what we can expect to happen in the future. Tonight's presentation is the first part of this.

Once we understand what is happening we can start to develop a plan.

Phase two:
What matters most?

HURUNUI District Council

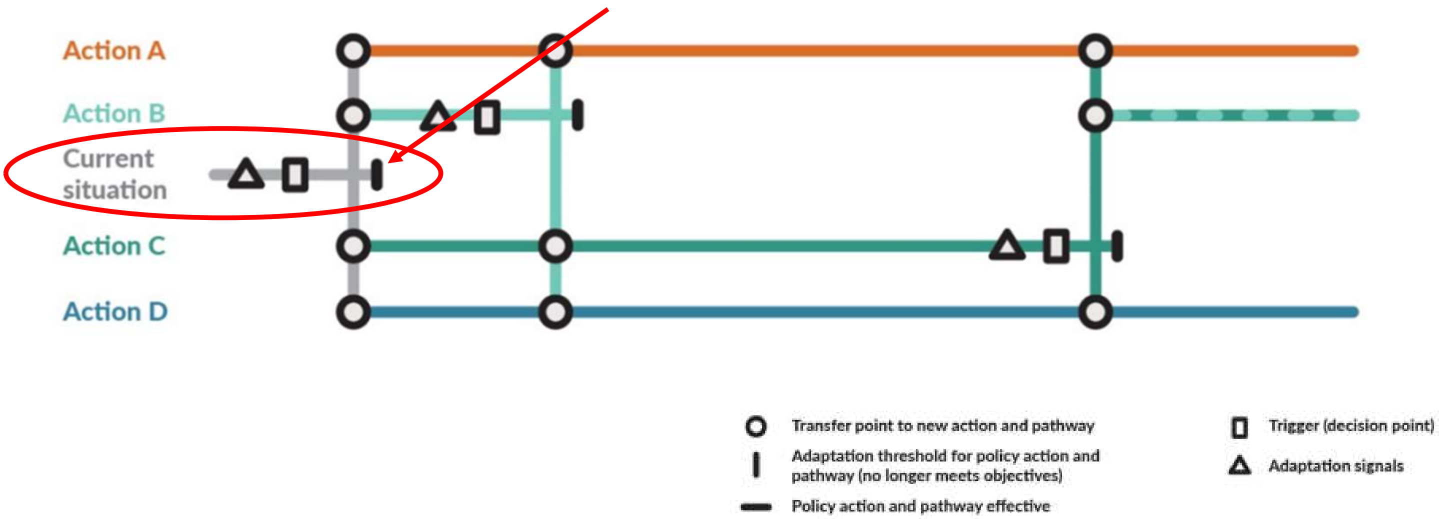
COASTAL CONVERSATIONS
The environment is changing, how will you?

What matters most?

For a plan to be successful decisions need to be based on the right framework. This framework needs to be specific to the particular community. We know the coast is important to everyone for different reasons.

Any plan must recognise and prioritise these values. Once we understand what these values are we can use them to build a decision making framework – effectively those values become the lens in which we look through when assessing various options.

Phase three:
What can we do about it?



HURUNUI District Council

COASTAL CONVERSATIONS
The environment is changing, how will you?

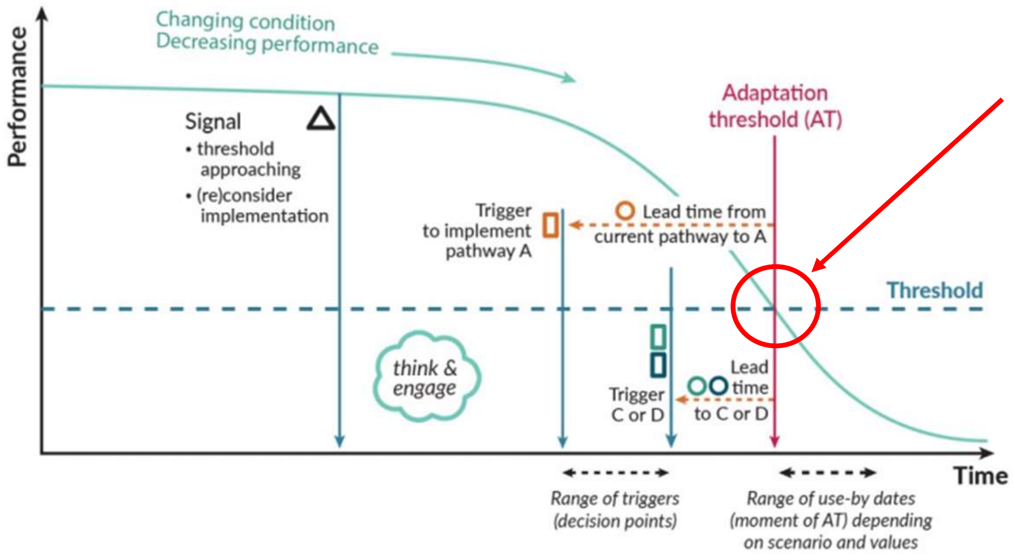
What can we do about it?

The image on the screen is an example of a dynamic adaptive pathway approach to planning. It shows that there is a time where the status quo will no longer protect the values identified in phase two. Before we reach this point we need to do something. This map shows that there are four possible options and there is the ability to move between various options. Each option has a different cost and a different life span.

Being an adaptive approach the end point of an option is based on a range of triggers. A trigger could be something visible like how often a piece of land is flooded in any given year or they could be more subtle but more constant like the depth to groundwater.

There is no timeframe associated with an action but there is an agreed point at which a particular situation is no longer acceptable. From this we can develop a plan to enable the preferred option or pathway when a change is required. An adaptive approach means no investment is required until necessary but it means we know what will happen if we get there.

Phase four:
How can we implement the strategy?



HURUNUI District Council

COASTAL CONVERSATIONS

The environment is changing, how will you?

How can we implement the strategy?

This shows how it all comes together. The blue dotted line shows the agreed minimum level of service or rather the point we have agreed is no longer acceptable. When the performance of the status quo decreases to this point something needs to be done immediately. However change takes time. Through identifying early warning signs and agreed trigger points we can ensure that the necessary change is ready to go when or just before it is needed.

Phase 1
- High level risk assessment
- Document community experiences and observations

Phase 2
- Establish what needs to be protected
- Determine a criteria to make decisions against

Phase 3
- Identify a range of options to achieve the outcomes agreed in Phase 2 and feasibility of these options

Phase 4
- Implementation plan recording agreed approach enabling long term planning

HURUNUI District Council

COASTAL CONVERSATIONS
The environment is changing, how will you?

In Summary

We can't do this alone. This is your future and this needs to be your plan. We would like today to be the start of a much longer conversation as we learn about the changing coastline together.

While we do need to do to have a plan we also need to make sure that this is the right plan and everyone has opportunity to design their future. This is your opportunity to look ahead.

Hurunui District Coastline Hazard and Risk Assessment

Conway Flat and Claverley

Presented by Derek Todd, Principal Coastal Hazards Scientist of Jacobs (New Zealand) Ltd

In 2019 Hurunui District Council (HDC) engaged with Jacobs NZ Ltd to undertake an assessment of how coastal hazards will change with projected climate change scenarios over the next 100 years at five settlements throughout the district, and what the risks to coastal settlements and critical council infrastructure could be.

These notes will provide extra detail for the slides presented by Derek Todd of Jacobs at the “Coastal Conversations” talk held for Conway Flat and Claverley on the 28th September 2020.

Agenda

1. **Scope of the Assessment**
2. **Coastal Inundation**
3. **Coastal Erosion**
4. **Rising Groundwater**

This presentation runs through the following items:

1. The scope of the assessment
2. The methods and the results of the coastal inundation assessment
3. The methods and results of the coastal erosion assessment
4. The methods and results of the rising groundwater assessment

Scope of Assessment

The following slide presents the scope of the assessment work.

Scope of Assessment

Undertake an assessment of how coastal hazards will change with projected climate change scenarios over the next 100 years, and the risks to coastal settlements and critical council infrastructure.

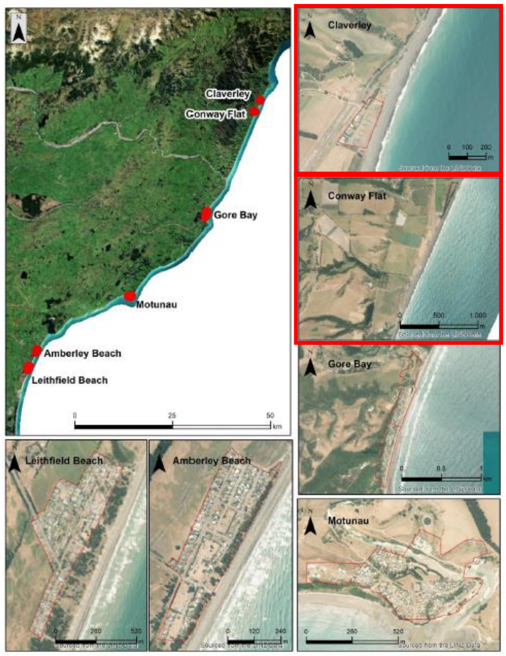
The three hazards covered in the assessment are:

- Coastal Erosion;
- Coastal Inundation; and
- Rising groundwater leading to shallow groundwater levels.

Five coastal settlements were assessed:

- Leithfield Beach;
- Amberley Beach;
- Motunau;
- Gore Bay; and
- **Claverley; and the section of Conway Flat Road that runs close to the coastal cliffs**

Dwellings, Properties and Council Infrastructure (wet wells, bore water supplies, roads and wastewater treatment ponds) were included in the high level risk assessment.



This slide outlines the scope of the *Hurunui District Coastline Hazard and Risk Assessment* report produced by Jacobs (2020).

The scope of this assessment was to:

- Create hazard maps of the likely extent of future coastal erosion, coastal inundation, and rising groundwater hazard, and increased salinity under a series of accepted sea level rise (SLR) scenarios.
- Undertake a high-level risk assessment on settlements and critical infrastructure to estimate the consequences of coastal erosion, inundation and groundwater rise associated with SLR on communities and council services.

There were three hazards covered within this assessment:

- Coastal erosion;
- Coastal inundation with sea water; and
- Rising groundwater leading to shallow groundwater levels

This assessment looked at the hazard footprint of these three hazards over a 30, 50, and 100 year timeframe.

Each of these hazards were assessed across five coastal settlements (as seen in the map on the right) which were assessed within the Hurunui District, and one area of shoreline where infrastructure was assessed (Conway Flat Road).

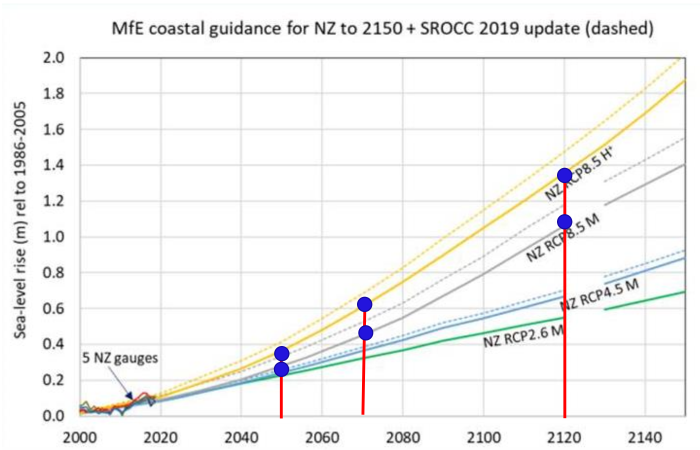
In the high-level risk assessment completed at each settlement, dwellings, properties and council infrastructure were assessed based on their intersection with the hazard footprint (e.g. whether the hazard overlays with a property). This was to give an indication of how many dwellings and properties could be affected in each timeframe as sea level rises.

Coastal Inundation Assessment

The following slides discuss the coastal inundation assessment methods and results.

Methodology

Sea level rise projections (MfE, 2017)



Year	RCP8.5 SLR Scenario		RCP8.5+ SLR Scenario	
	SLR from 2020 Baseline	Rate of accelerated rise	SLR from 2020 Baseline	Rate of accelerated rise
2050 (30 Year)	+0.23 m	5.7 mm/yr	+0.32 m	8.7 mm/yr
2070 (50 Year)	+0.40 m	6.0 mm/yr	+0.56 m	9.2 mm/yr
2120 (100 Year)	+1.01 m	8.1 mm/yr	+1.31 m	11.1 mm/yr

6

This slide shows the sea level rise projections used in this assessment, which are projections from the Ministry for the Environment (2017) *Coastal Hazards and Climate Change: Guidance for Local Government.*

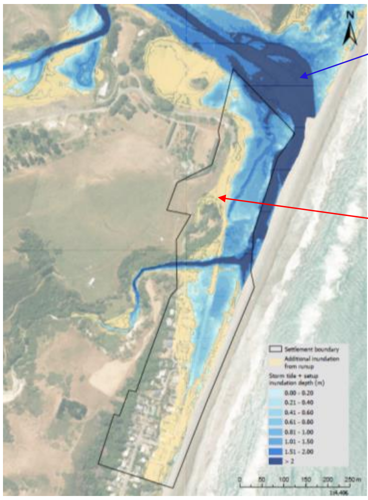
There are four commonly accepted sea level rise/climate change scenarios used both nationally and internationally, which are recognised by the New Zealand government. These scenarios are termed RCPs (Representative Concentration Pathways), and are based on the following global emissions scenarios:

- RCP2.6 – low/reduced emission
- RCP4.5 – moderate then declining emissions
- RCP8.5 – continuing status quo high emissions
- RCP8.5+ - continuing status quo high emissions and possible instabilities in the polar ice sheets

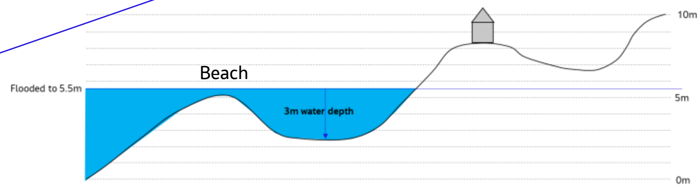
In this assessment, we looked at sea level rise over a 30, 50 and 100 year time frame (three red vertical lines) for a RCP8.5 and RCP8.5+ sea level rise scenario (blue dots) on the curved yellow and red lines), in which the sea level rise in metres in each of these scenarios is detailed in the table at the bottom of the slide.

As can be seen in this graph, there is less certainty around sea level rise projections as time progresses. We can be fairly certain about sea level rise over the next 30 years, moderately certain about sea level rise over the next 50 years, and there is some uncertainty around the magnitude of sea level rise we could expect over the next 100 years.

Methodology – *Coastal Inundation*



Blue = Bathtub Modelling



Yellow = Overtopping Volume Calculations

Table 2.5: 1% AEP event static water levels used in this study.

Year	RCP	Leithfield Beach	Amberley Beach	Motunau	Gore Bay (south)	Gore Bay (north)	Conway Flat	Claverley
Present Day		3.51 m	2.84 m	3.82 m	3.26 m	3.41 m	2.95 m	2.95 m
30 year (2050)	8.5	3.79 m	3.12 m	4.1 m	3.54 m	3.69 m	3.23 m	3.23 m
50 year (2070)	8.5	3.9 6m	3.29 m	4.27 m	3.71 m	3.86 m	3.40 m	3.40 m
	8.5+	4.12 m	3.45 m	4.43 m	3.87 m	4.02 m	3.56 m	3.56 m
100 year (2120)	8.5	4.57 m	3.90 m	4.88 m	4.32 m	4.47 m	4.01 m	4.01 m
	8.5+	4.87 m	4.20 m	5.18 m	4.62 m	4.77 m	4.31 m	4.31 m

7

This slides provides an overview of the approach used to assess the future coastal inundation hazard at each settlement. Further detail and explanation of the methods can be found in the report at www.hurunui.govt.nz/coastal

Two methods were used to determine the future coastal inundation hazard at each settlement:

1) Bathtub modelling:
2) Volumetric calculation of water overtopping the beach

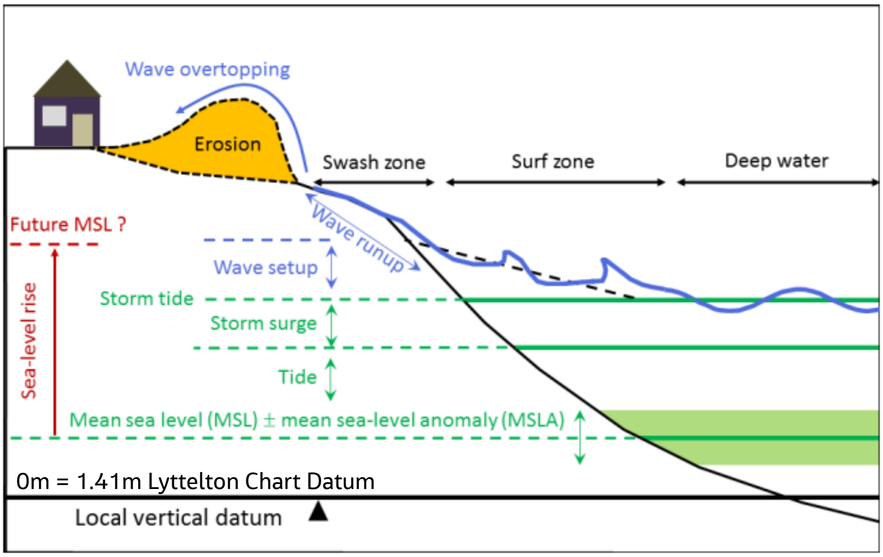
Bathtub model

- Bathtub modelling is a simplified flood model which floods land with elevations less than a set static water level, and has a connection to the sea. This is shown conceptually in the diagram on the top right of this slide, and is represented on the inundation hazard maps as the shaded blue area, which represent depth of water.
- The set 'static' water level used is a combination of wave set up, storm surge, astronomical tide, and sea level rise. The table on the bottom right of the slide shows the combined water levels used over each timeframe at each settlement.
- It is considered to be a conservative approach but it provides a basis for whether or not to proceed with more detailed and expensive hydrodynamic modelling.

Volume overtopping calculations from run-up:

- The yellow areas of the map shown on the left of this slide are the additional potential areas which could be inundated by wave overtopping caused by wave run-up on the beach. This is an additional component that is not input into the bathtub model.
- These areas were determined by calculating the likely volume of water that could overtop the beach in a 12 hour period with consideration of the tidal cycle.
- There is no depth associated with the areas shaded yellow, they are additional areas which could be effected by run-up, but it is unknown how deep the water would be there.

For this assessment, the combined water level used was a present day 1 in 100 year flood event combined with sea level rise for the 30, 50 and 100 year periods.



This slide shows the different components used to determine the ‘static’ water level – Astronomical tide, storm surge, wave setup and SLR.

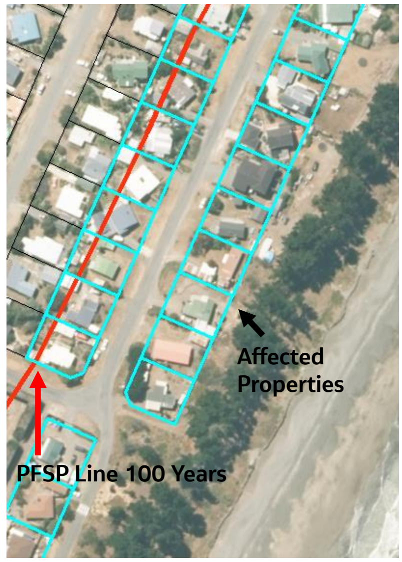
Methodology – *Risk Assessment*

Risk = Consequence x Likelihood

The impact if the event occurs | Probability of occurrence

Assets assessed for each hazard:

Hazard	# of Dwellings	# of Properties	Critical Infrastructure
Coastal Erosion		X	X
Coastal Inundation	X	X	X
Rising Groundwater	X	X	X



9

This slide outlines the approach used to conduct a high level risk assessment of each hazard in each settlement. Further details on the methods used can be found in the report at www.hurunui.govt.nz/coastal

Risk is assessed as the consequence of the event, combined with the likelihood of that event occurring.

In this assessment, the consequence on the event was assessed by calculating the intersection of the hazard footprint with an asset (e.g. key critical infrastructure, dwellings, properties).

The table on the bottom left shows what assets were assessed for each hazard (e.g. dwellings, properties, key infrastructure), and the map on the right shows an example of how the number of properties effected were calculated for the erosion hazard.

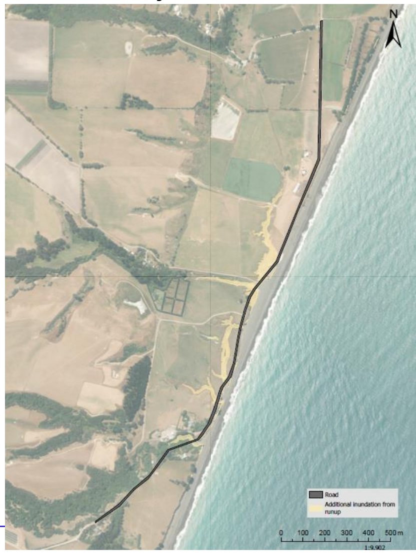
Key infrastructure at each settlement was identified by Hurunui District Council. These were different for each settlement, but included roads, wet wells and waste water treatment ponds.

Properties and Dwellings were based on information from Land Information New Zealand (LINZ). Where possible, garages and sheds were removed from the building footprints provided by LINZ, however in some instances these could not be distinguished, and therefore some properties have more than one 'dwelling' on them, and are accounted for in the total numbers produced for each settlement.

At Conway Flat, only the road was assessed for risk. At Claverley, properties, dwellings and Claverley road were included in the risk assessment.

Conway Flat

Present Day 1 in 100 Year Storm



30 Year (RCP 8.5) 1 in 100 Year Storm

10

This slide shows a the results of the coastal inundation hazard at Conway Flat for a 1 in 100 year storm for the present day (0m SLR), and in 30 years (0.28m of SLR).

The blue areas on the map show the indicative depth of water in this event, and yellow areas show the additional area which could be effected due to runup. Inundation shown along the river is indicative and has not taken into account fluvial or tidal processes.

<u>**Present Day and 30-year RCP 8.5 Scenario for a 1 in 100 year storm**</u>

- The map on the *left* shows the hazard footprint at the present day, with no sea level rise.
- The map on the *right* shows the hazard footprint with 30 years, with 0.28m of SLR.
- Under present day and 30-year SLR scenarios any inundation would be as a result of wave run-up overtopping the beach barrier fronting these streams and watercourses.

Conway Flat

30 Year (RCP 8.5) 1 in 100 Year Storm

Potential Inundation Depths at Conway Flat Road:

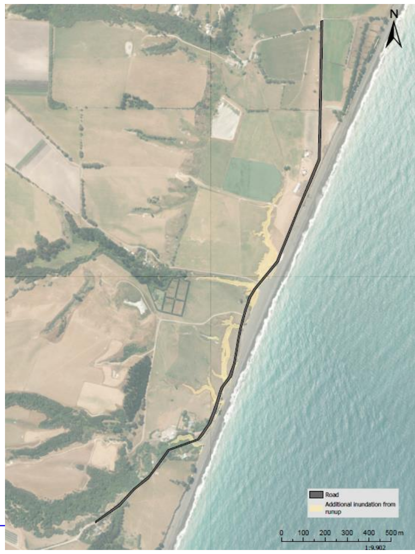
Infrastructure	Present day (2020)	30-year (2050)	50-year (2070)		100-year (2120)	
Infrastructure		RCP 8.5	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Road (% of total road affected)	0%	0%	2%	3%	3%	3%
Road (average inundation depth)	Not inundated	Not inundated	0.2m	0.4m	0.8m	1.1m

This slide shows the results of the risk assessment for the 30 year inundation hazard, the map on the right of this slide.

Key infrastructure at Conway Flat was assessed in the risk assessment was the road, and the length of road that could be affected (e.g. limit access along the road).
In both present day and 30-year scenarios, none of the road is predicted to be inundated in this event.

Conway Flat

Present Day 1 in 100 Year Storm



50 Year (RCP 8.5) 1 in 100 Year Storm

12

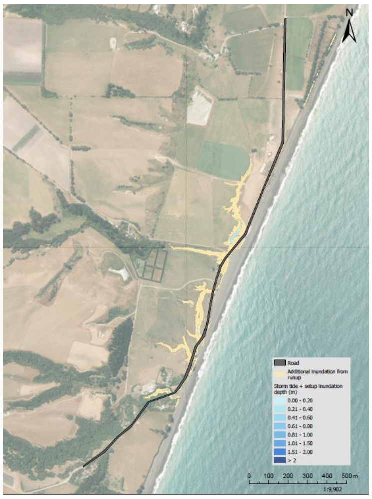
This slide shows a the results of the coastal inundation hazard at Conway Flat for a 1 in 100 year storm for the present day (0m SLR), and in 50 years (0.45m of SLR).

<u>50 year (RCP8.5) 1 in 100 year storm</u>

- The map on the *right* shows the hazard footprint with 50 years, with 0.45m of SLR.
- Under the 50-year RCP 8.5 scenario the 1 in 100 year static water level could extend up small coastal inlets and may affect approximately 20 m Conway Flat Rd at the southern end of the study area with 0.2m water depth.
- In the 50-year RCP 8.5+ scenario, the spatial extent of the hazard increases in these isolated inlets and the depth also increases.

Conway Flat

50 Year (RCP 8.5) 1 in 100 Year Storm

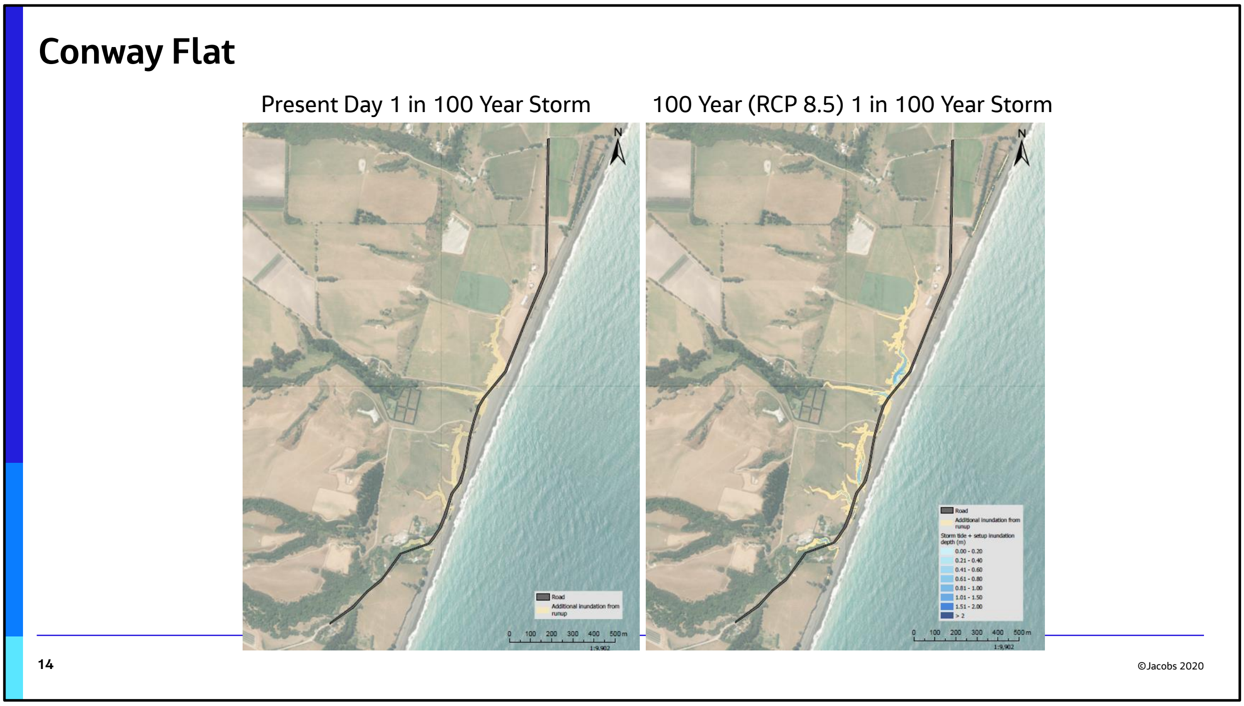


Potential Inundation Depths at Conway Flat Road:

Infrastructure	Present day (2020)	30-year (2050)	50-year (2070)		100-year (2120)	
Infrastructure		RCP 8.5	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Road (% of total road affected)	0%	0%	2%	3%	3%	3%
Road (average inundation depth)	Not inundated	Not inundated	0.2m	0.4m	0.8m	1.1m

This slide shows the results of the risk assessment for the 50 year inundation hazard, the map on the right of this slide.

Key infrastructure at Conway Flat was assessed in the risk assessment was the road, and the length of road that could be affected (e.g. limit access along the road).
Approximately a 50m section of the road at the northern extent of the study area could also become inundated but only with 0.1m of water, and the inundation at the previously mentioned southern road section increases up to 0.4m water depth.



This slide shows a the results of the coastal inundation hazard at Conway Flat for a 1 in 100 year storm for the present day (0m SLR), and in 100 years (1.06m of SLR).

<u>100 year (RCP8.5) 1 in 100 year storm</u>

- The map on the *right* shows the hazard footprint with 100 years, with 1.06m of SLR.
- In the 100-year RCP 8.5 scenario, the spatial extent of the inundation footprint continues to increase, and the potential depth across Conway Flat Rd could increase to 0.5-0.8 m.
- In the 100-year RCP 8.5+ scenario, the hazard extent continues to increase, and the depth of water across the road at the coastal inlets could increase to 0.8-1m.

Conway Flat

100 Year (RCP 8.5) 1 in 100 Year Storm

Potential Inundation Depths at Conway Flat Road:

Infrastructure	Present day (2020)	30-year (2050)	50-year (2070)		100-year (2120)	
Infrastructure		RCP 8.5	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Road (% of total road affected)	0%	0%	2%	3%	3%	3%
Road (average inundation depth)	Not inundated	Not inundated	0.2m	0.4m	0.8m	1.1m

15

This slide shows the results of the risk assessment for the 100 year inundation hazard, the map on the right of this slide.

Key infrastructure at Conway Flat was assessed in the risk assessment was the road, and the length of road that could be affected (e.g. limit access along the road).
Approximately 3% of the road could be affected by flooding along Conway flat road, with potential water depths being in the order of 0.8m to 1.1m.

Claverley

Present Day 1 in 100 Year Storm

30 Year (RCP 8.5) 1 in 100 Year Storm

No dwellings or properties intersect with the coastal hazard footprint in any SLR scenario

16

This slide shows a the results of the coastal inundation hazard at Claverley for a 1 in 100 year storm for the present day (0m SLR), and in 30 years (0.28m of SLR).

The blue areas on the map show the indicative depth of water in this event, and yellow areas show the additional area which could be effected due to runup. Inundation shown along the river is indicative and has not taken into account fluvial or tidal processes.

There was no inundation from this event at Claverley in both the present day and 30-year 1 in 100 year events. No dwellings or properties were predicted to be effected by inundation in these scenarios.

Claverley

Present Day 1 in 100 Year Storm

50 Year (RCP 8.5) 1 in 100 Year Storm

No dwellings or properties intersect with the coastal hazard footprint in any SLR scenario

17

This slide shows a the results of the coastal inundation hazard at Claverley for a 1 in 100 year storm for the present day (0m SLR), and in 50 years (0.45m of SLR).

The blue areas on the map show the indicative depth of water in this event, and yellow areas show the additional area which could be effected due to runup. Inundation shown along the river is indicative and has not taken into account fluvial or tidal processes.

There was no inundation from the 50-year RCP 8.5 or 8.5+ scenarios in this event at Claverley.
No dwellings or properties were predicted to be effected by inundation in these scenarios.

Claverley

Present Day 1 in 100 Year Storm

100 Year (RCP 8.5) 1 in 100 Year Storm

No dwellings or properties intersect with the coastal hazard footprint in any SLR scenario

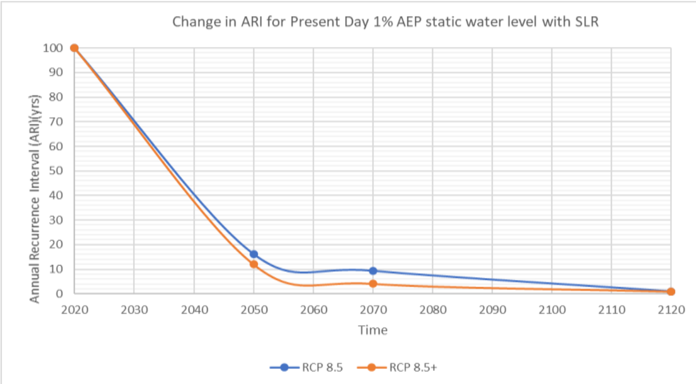
18

This slide shows a the results of the coastal inundation hazard at Claverley for a 1 in 100 year storm for the present day (0m SLR), and in 100 years (1.06m of SLR).

The blue areas on the map show the indicative depth of water in this event, and yellow areas show the additional area which could be effected due to runup. Inundation shown along the river is indicative and has not taken into account fluvial or tidal processes.

There was no inundation from the 100-year RCP 8.5 or 8.5+ scenarios in this event at Claverley.
No dwellings or properties were predicted to be effected by inundation in these scenarios.

Increase in Frequency of 1 in 100 Year Events with SLR



1 in 100 year event could occur every:

- 12-16 Years by 2050
- 5-10 Years by 2070
- Year by 2120

This slide shows the change in recurrence intervals of a 1 in 100 year event with sea level rise.

As well as water levels, future SLR will also increase the annual probability (e.g. frequency) that the present day 1 in 100 year event will occur.

As shown in in the graph on this slide, the Annual Recurrence Interval (ARI) for the present day 1 in 100 year event with no sea level rise reduces from the current 100 years to:

- 12-16 years by 2050;
- 5-10 years by 2070; and
- Annually by 2120.

Expressed another way, experiencing this area and depth of flooding, you would currently only expect it to occur once in 100 years at present. With SLR over 30, 50 and 100 years, it is six to eight times as likely to occur in any one year by 2050, in the order of ten to twenty times more likely to occur in any one year by 2070, and could occur every year by 2120.

Coastal Erosion Assessment

The following slides discuss the coastal erosion assessment methods and results.

Methodology – *Coastal Erosion*

Projected Future Shoreline Position (PFSP) = (LT x T) + SL + ST

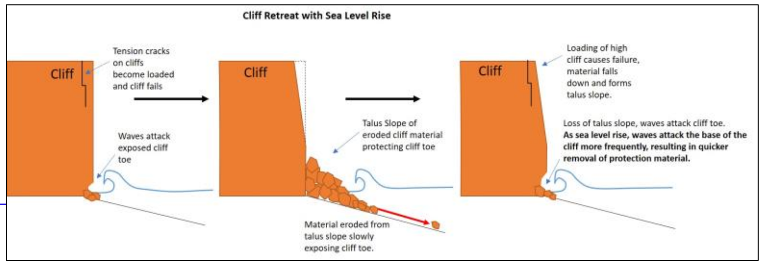
Where:

- ***T*** *= Timeframe considered (30, 50, 100 years);*
- ***LT*** *= Extrapolation of the rate of historical shoreline movement (m/yr);*
- ***SL*** *= Estimated erosion due to accelerated sea level rise over the timeframe (T); and*
- ***ST*** *= Short-term storm erosion*

Long Term

Short Term Storm Erosion

SLR Effect (next slide)



21

This slides provides an overview of the approach used to assess the future <u>erosion hazard</u> at each settlement. Further detail and explanation of the methods can be found in the report at www.hurunui.govt.nz/coastal

When assessing coastal erosion hazard into the future, there are three key components to consider:

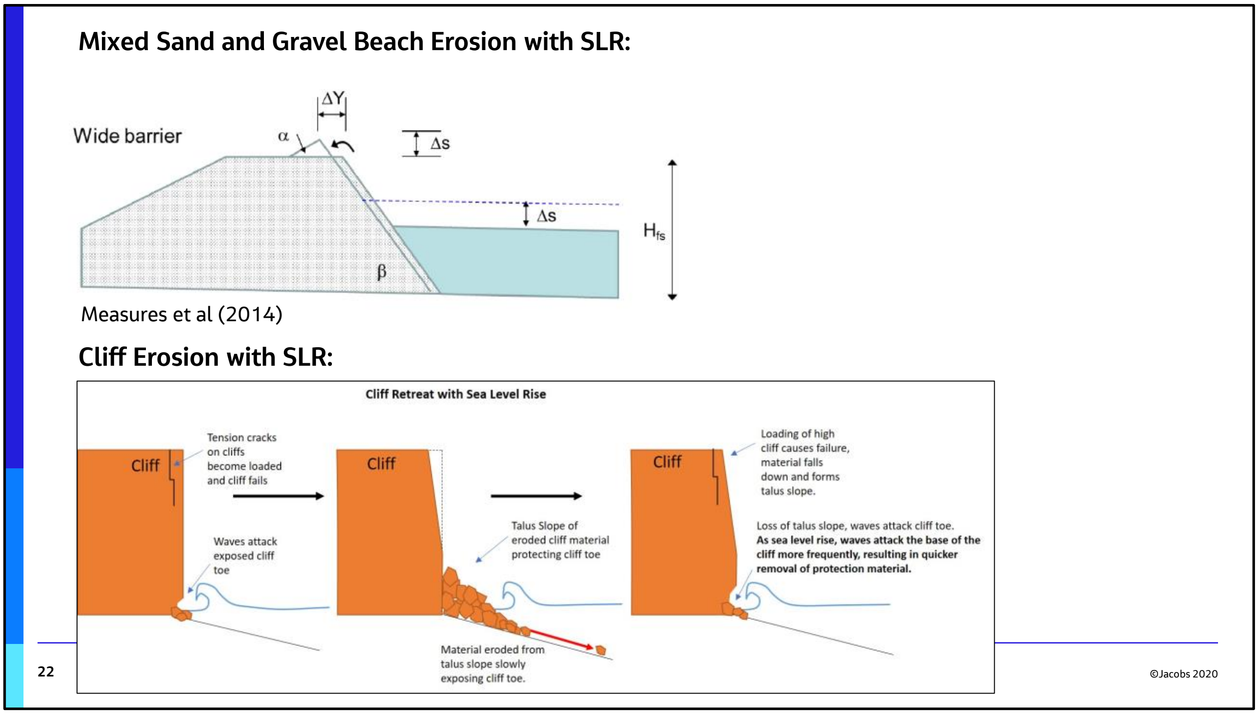
1. **Long term trend** – This is considered to ensure that the past trend at the site (e.g. accretion due to good sediment supply, or erosion due to sediment deficit) is taken into account when determining where the shoreline will be in the future. This is calculated using historical aerial imagery from the site;
2. **Effect of sea level rise** – The inclusion of the effect of accelerated sea level rise in the future shoreline position is to account for the erosional response on the beach to rising sea levels. This is calculated using two- dimensional geometric models which are adjusted depending on the morphology of the beach. *There is more information about this on the following slide.*
3. **Short term erosion** – The inclusion of short-term erosion as a component in the PFSP calculation is to account for an extreme storm event or series of events resulting in significant erosion occurring close to or soon after the end of the planning timeframe. This is calculated using ECan beach profiles and calculating year-to-year changes between profiles.

These components are combined in the following formula to calculate the position of the Projected Future Shoreline Position (PFSP), in which this approach meets the requirements of NZCPS Policy 24 for the identification of coastal hazards:

PFSP = (Long **T**erm **x T**imeframe**) + S**ea **L**evel Rise effect **+ S**hort **T**erm

.

The PFSP lines seen on the maps in each settlement and at Conway Flat Road are a combination of all three components, and represent where the back of the beach (e.g. the vegetation line or cliff line) could be in 30, 50 and 100 years under two different sea level rise scenarios.

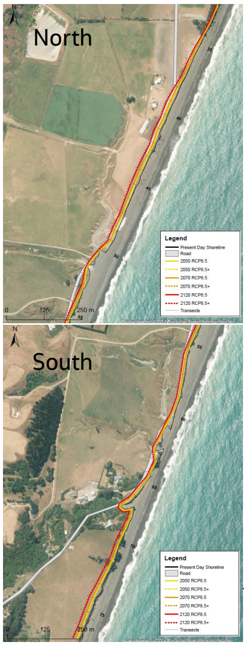


This slide shows conceptually the two different geometric models used in this assessment to calculate the erosional effect of SLR.

The top diagram shows the conceptual response of a mixed sand and gravel beach, where the beach profile moves upwards and landwards. This model of based on the concept that gravel is taken from the beach profile in elevate the nearshore bed at the same magnitude that sea level is rising to maintain an equilibrium profile. This geometric model was used at Claverley.

The bottom diagram shows the conceptual response of cliffs to SLR, where SLR will result in more frequent wave attack on the cliff toe. As a result the cliff becomes over-loaded and fails. These erosion events occur episodically rather than gradually, as eroded cliff material provides protection at the cliff toe for a period of time until it is eroded away and the cliff toe is exposed again. This geometric model was used at Conway Flat.

Reference: Measures et al., (2014). Analysis of Te Waihora lake level control options: A Whakaora Te Waihora science project. *Prepared for Ngai Tahu and Environment Canterbury.*



Conway Flat:

1. **Extrapolation of Historical Shoreline Movements**

Scenario	30 years (2050)	50 years (2070)	100 years (2120)
Transect 35 (alluvial cliff north of road)	-2.1 m	-3.5 m	-7.0 m
Transect 45 (alluvial cliff)	-3.3 m	-5.5 m	-11 m
Transect 60 (loess cliff)	-1.8 m	-3.0 m	-6 m
Transect 70 (loess cliff- southern end of road)	-3.3 m	-5.5 m	-11 m

2. Effect of SLR

30 Years = -0.3m to -1.3m
50 Years = -0.7m to -2.7m
100 Years = -2.6m to -6.7m

3. Short Term Erosion Effect: Estimated to be -3m

This slide presents the results of the Coastal Erosion hazard assessment for 30, 50 and 100 year timeframes.

1. Historical Shoreline Trend

- Average rates along the alluvial cliffs where Conway Flat Rd is closest to the edge (e.g. Transects 38-50) were -0.11 m/yr since 1950
- Along the loess cliff section, erosion rates were -0.07 m/yr.
- The maximum erosion rate at an individual transect is -0.38 m/yr located at the southern edge of the high alluvial terrace, and most likely influenced by stream erosion from the watercourse that discharges at this location.

2. Effects of Accelerated SLR

The effects of accelerated SLR at Motunau are calculated as the following:

- Over the next 30 years there could be -0.3m to -1.3m
- Over the next 50 years there could be -0.7m to -2.7m of erosion as a direct result of SLR; and
- Over the next 100 years there could be -2.6m to -6.7m of erosion as a direct result of SLR.

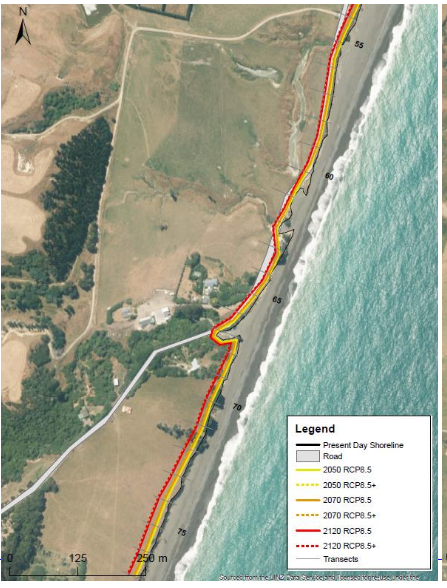
3. Short Term Erosion

An assessment of Environment Canterbury beach profiles between 1997-2015 revealed that the maximum inter-survey erosion ranged from -1.22m to -2.51m. Adopting this upper limit, an arbitrary value of 3m was used as the short-term erosion component for the PFSP for Conway Flat.

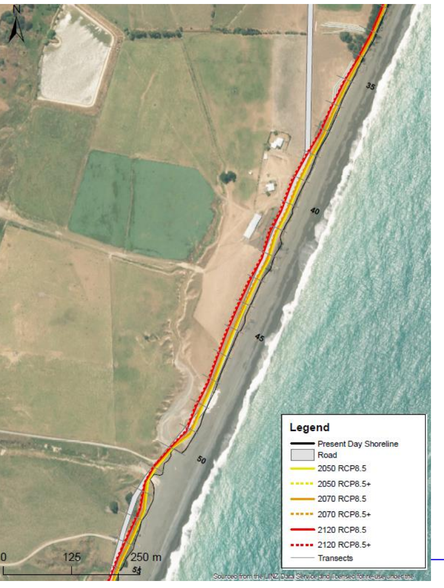
These three components are then combined to calculate the Projected Future Shoreline Positions seen on the map on the left and the next slide.

Conway Flat

South



North

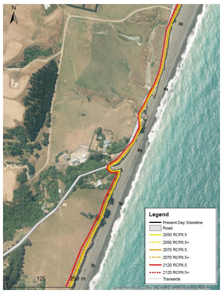


24

This slide presents the results of the projected future shoreline position for 30, 50 and 100 year timeframes in Conway Flat.

Conway Flat

South



North

PFSP Average Erosion Distances:

Timeframe	30 years (2050)		50 years (2070)		100 years (2120)	
Scenario	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Transect 35 (Northern end of the road along the cliff)	-5 m	-6 m	-7 m	-8 m	-12 m	-14 m
Transect 45	-7 m	-8 m	-10 m	-11 m	-19 m	-22 m
Transect 60	-5 m	- 6 m	-7 m	-8 m	-12 m	-13 m
Transect 70 (Southern end of road along the cliff)	-7 m	-8 m	-10 m	-11 m	-18 m	-22 m

Lengths of Road Affected:

Timeframe	Total	30-year (2050)	50-year (2070)		100-year (2120)	
Scenario		RCP 8.5	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Indicative length of road affected	1500m	550m	950m	1000m	1300m	1300m

25

This slide presents the results of the Coastal Erosion hazard assessment for 30, 50 and 100 year timeframes.

<u>Projected Future Shoreline Positions</u>

The table on the top right of this slide shows the distance of the projected future shoreline position from the present day shoreline (cliff edge and vegetation line) for each scenario. These distances are shown spatially on the map on the left (and on the previous slide).

These distances can be summarised as the following:

- In 2050, the shoreline could be in the order of -5 to -8m landward of its current position;
- In 2070, the shoreline could be in the order of -7 to -11m landward of its current position; and
- In 2120, the shoreline could be in the order of -12 to -22m landward of its current position.

The extrapolation of the long-term erosion component will be the main contribution to retreat over the next 50 years at Motunau, and that accelerated rates of SLR will only begin to contribute more than 50% of the projected erosion over a 100-year timeframe.

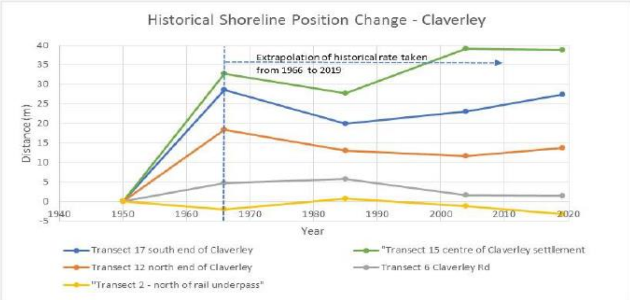
From comparing the individual component results with the overall projected erosion distances, the accelerated SLR will only contribute < 20% of the projected erosion by 2050, in the order of 15-24% by 2070, and 25-33% by 2120. In the immediate future the largest contribution to the position of the PFSP is short-term episodic erosion from storms or earthquakes, with the extrapolation of current long-term rates becoming the dominant factor within 50 years.

<u>Coastal Erosion Risk Assessment</u>

The purpose of the risk assessment is the 1.5 km stretch of Conway Flat Rd that fronts the shoreline. The resulting lengths of road at risk under the different SLR scenarios are presented in the bottom left table, which indicates 35% of the road length is at risk within 30 years, increasing to 65% in 50 years, and 85% within 100 years.

Claverley

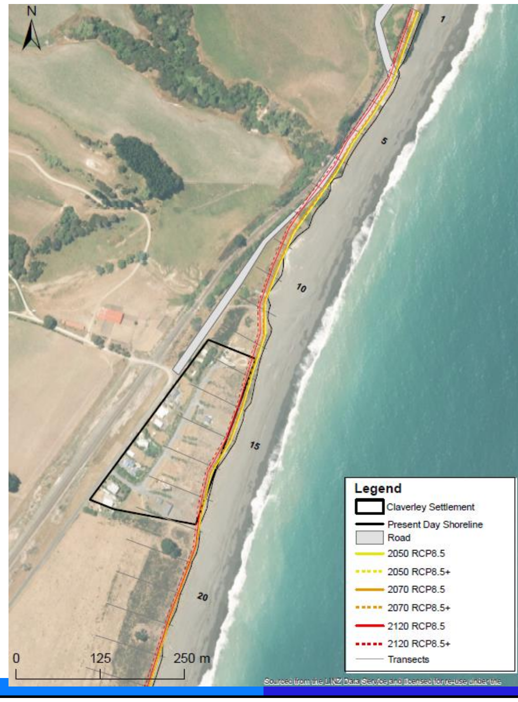
1. Historical Shoreline Position Change and extrapolation of past trends:



2. Effect of SLR

30 Years = -1.6m to -2.6m
50 Years = -2.9m to -4.6m
100 Years = -8m to -11.2m

3. Short Term Erosion Effect: Estimated to be -4m



This slide presents the results of the Coastal Erosion hazard assessment for 30, 50 and 100 year timeframes.

1. Historical Shoreline Trend

- All transects except those north of the rail underpass has experienced a net accretion since 1950, but with generally stable trends with small scale dynamic fluctuations since 1966.
- The reason for the change from relatively rapid net accretion in the 1950-1966 period to a more dynamic equilibrium is not clear, as there is no indication in reduction of sediment supply from the Conway River.
- As a conservative approach to the extrapolation of historical rates for input into the determination of the PFSP position, only shoreline advance rates since 1966 have been used.

Extrapolation of these historical rates range from:

- -2.1m (North) to +2.4m (South) for 30 years;
- -3.5m (North) to +4m (South) for 50 years;
- -7m (North) to +8m (South) for 100 years

2. Effects of Accelerated SLR

The effects of accelerated SLR at Claverley are calculated as the following:

- Over the next 30 years there could be -1.6m to -2.6m of erosion as a direct result of SLR;
- Over the next 50 years there could be -2.9m to -4.6m of erosion as a direct result of SLR; and
- Over the next 100 years there could be -8m to -11.2m of erosion as a direct result of SLR.

3. Short Term Erosion

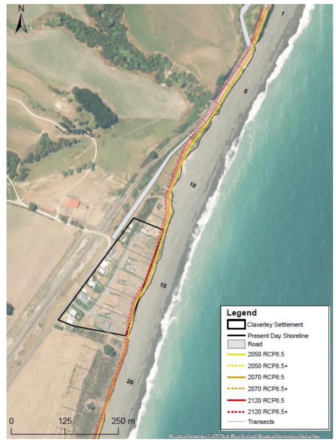
An assessment of Environment Canterbury beach profiles between 1997-2015 revealed that the maximum inter-survey erosion was -3.8m.
An arbitrary value of -4m was used as the short-term erosion component for the PFSP for the Claverley settlement.

These three components are then combined to calculate the Projected Future Shoreline Positions seen on the map on the right.

Claverley

PFSP Average Erosion Distances:

Timeframe	30 years (2050)		50 years (2070)		100 years (2120)	
Scenario	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Transect 17 (Southern end of settlement)	-3 m	-4 m	-3 m	-5 m	-4 m	-7 m
Transect 15 (Centre of settlement)	-5 m	-6 m	-7 m	-8 m	-11 m	-14 m
Transect 12 (Northern end of settlement)	-6 m	-7 m	-8 m	-10 m	-14 m	-17 m
Transect 6 (Claverley Rd nth of settlement)	-8 m	-9 m	-10 m	-12 m	-19 m	-22 m
Transect 2 (north of rail underpass)	-6 m	-7 m	-8 m	-10 m	-14 m	-17 m



Number of properties and length of road affected by erosion:

Timeframe	Total	30-year (2050)		50-year (2070)		100-year (2120)	
Scenario		RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+	RCP 8.5	RCP 8.5+
Number of properties	13	2	2	2	2	8	8
Claverley Rd lengths		Rail bridge underpass	Rail bridge underpass	150 m	150 m	250 m	250 m

This slide presents the results of the Coastal Erosion hazard assessment for 30, 50 and 100 year timeframes.

Projected Future Shoreline Positions

The table on the top left of this slide shows the distance of the projected future shoreline position from the present day shoreline (vegetation line) for each scenario. These distances are shown spatially on the map on the right (and on the previous slide).

These distances can be summarised as the following:

- In 2050, the shoreline could be in the order of -3m to -9m landward of its current position;
- In 2070, the shoreline could be in the order of -3m to -12m landward of its current position; and
- In 2120, the shoreline could be in the order of -4m to -22m landward of its current position.

The largest contribution to the position of the PFSP over the next 30 years to 50 years is the short-term storm erosion being up to or more than 50% of the total erosion distance. North of the settlement, the extrapolated long-term erosion contributes 10 –25% of the total erosion distance over the next 50 years, with accelerated SLR effects contributing 20-40%.

Coastal Erosion Risk Assessment

Properties: The property numbers presented in the bottom table. Of the 13 properties within the Claverley footprint, 2 properties (15%) are projected to be at risk from erosion over the next 30 and 50 years, and this increases to 8 properties (62%) over the next 100 years.

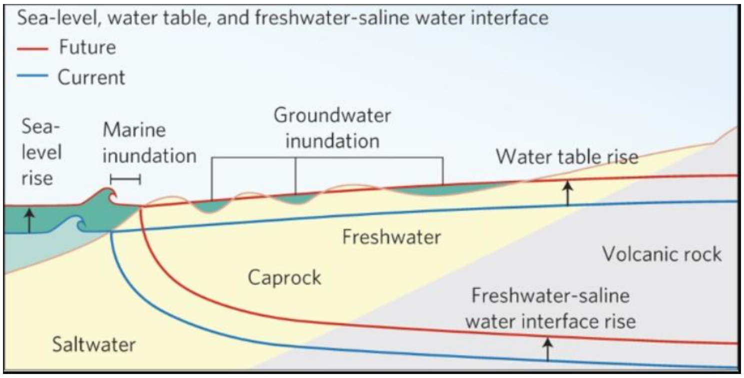
Critical Infrastructure: The Rail bridge underpass is likely to be affected within the next 30 years by erosion. Within 50 years, 150m of Claverley Road is likely to be affected by erosion. This increases to 250m of Claverley Road being affected by 2120.

Groundwater Assessment

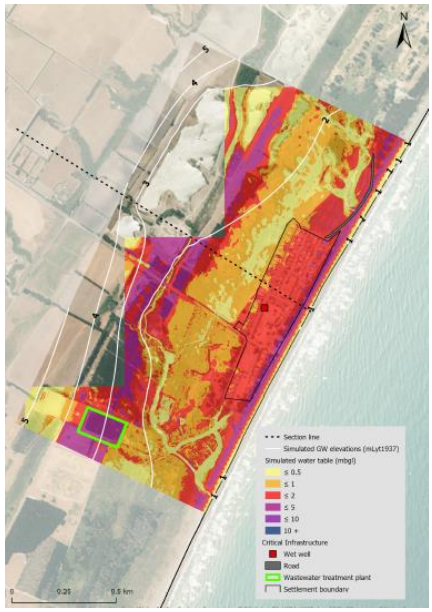
The following slides discuss the rising groundwater assessment methods and results.

Methodology – *Rising Groundwater*

- Calculating the depth to Groundwater with SLR
- Predicting the saline interface with SLR



Rotzall & Fletcher (2013)



29

This slide provides an overview of the approach used to assess the <u>rising of shallow groundwater</u> at each settlement. Further detail and explanation of the methods can be found in the report at www.hurunui.govt.nz/coastal

Two components of groundwater hazards were assessed in the Hurunui District:
1) Rising shallow groundwater with sea level rise; and
2) Ingress of the saline interface with sea level rise as seawater encroaches into the groundwater table

There were several limitations to calculating the rising groundwater hazard in the Hurunui District due to the lack of data available, and therefore only 50 year and 100 year scenarios were assessed.

The figure on the left (from Rotzall & Fletcher, 2013) shows an example of the effect of SLR on the water table and the saline interface. It demonstrates how groundwater water quality can be effected as the freshwater-saline interface moves inland with SLR, as well as reducing the ability for land to drain as the water table rises.

In this assessment, the change in the saline interface was assessed, which could have an effect on the water quality at a site where there is saltwater intrusion into water supplies or water treatment areas.

The map on the right shows an example of the output of the modelling assessing the rise in shallow groundwater, which shows the depth to ground water below 0m, which gives an indication of areas where the drainage capacity of the land could be reduced with sea level rise.

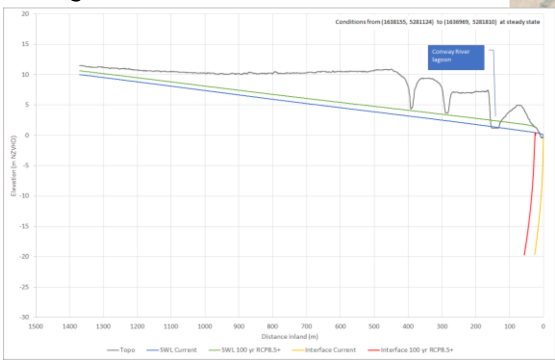
Rotzoll, K., Fletcher, C. Assessment of groundwater inundation as a consequence of sea-level rise. *Nature Clim Change* 3**,** 477–481 (2013)

Conway Flat

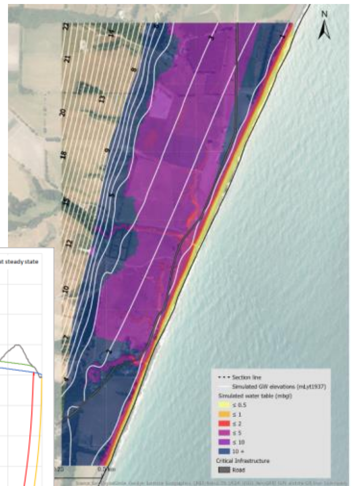
Average Depth to GW at Road:

Infrastructure	Present Day (2020)	100-year (2120) RCP 8.5+
Road	2-5m	2-5m

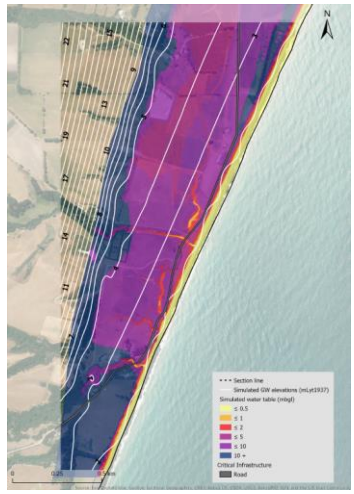
Change in Saline Interface:



Present Day:



100 Year (RCP8.5+):



©Jacobs 2020

This slide shows the results of the shallow groundwater mapping in the present day, and with 100 years SLR (RCP 8.5+) at Conway Flat.

The RCP 8.5+ 100yr SLR scenario does not show groundwater depths being <2m BGL except for along the foreshore, and up the smaller inlets. There are not considered to be any significant impact of rising groundwater, so the intermediate 50-year scenario was not run.

Depth to groundwater along the road is between 2-5m in both scenarios (present day and 100 years), and therefore is unlikely to be an issue at Conway Flat in the future.

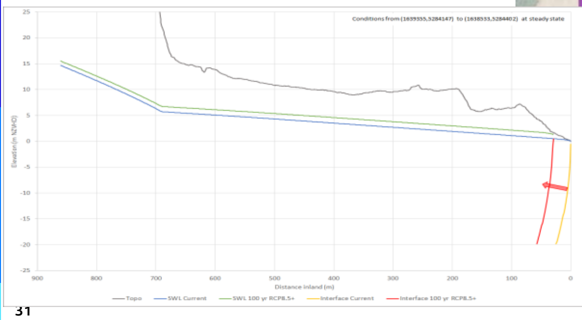
The change in the saline interface is mapped on the bottom left graph. This shows that there will not be significant ingress of the saline interface that would effect any water supply in the area.

Claverley

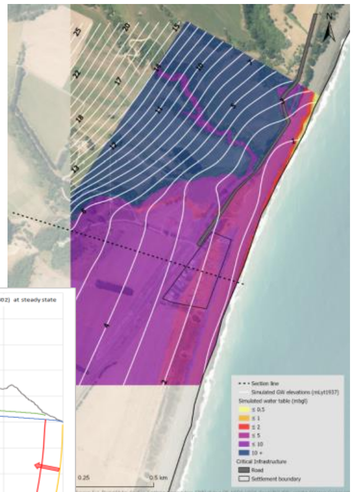
Average Depth to GW at Road:

Infrastructure	Present day (2020)	100-year RCP 8.5+ (SLR=1.3 m)
Road	2-5m	1-2m

Change in Saline Interface:



Present Day:



100 Year (RCP8.5+):

31

©Jacobs 2020

This slide shows the results of the shallow groundwater mapping in the present day, and with 100 years SLR (RCP 8.5+) at Claverley.

The RCP 8.5+ 100yr SLR scenario does not show groundwater depths being <2m BGL except for along the foreshore, and up the smaller inlets. There are not considered to be any significant impact of rising groundwater, so the intermediate 50-year scenario was not run.

Depth to groundwater along the road is between 2-5m at present, and is between 1-2m in 100 years, and therefore is unlikely to be an issue at Claverley in the future. No dwellings are projected to be at risk from groundwater rise over the next 100 years.

The change in the saline interface is mapped on the bottom left graph. This shows that there will not be significant ingress of the saline interface that would effect any water supply in the area.

Thank you

Jacobs

Challenging today.
Reinventing tomorrow.

Copyright Notice

Important