

A wide-angle photograph of a coastal landscape. In the foreground, there is a grassy dune area with some low-lying green plants. A sandy beach stretches across the middle ground, leading to the ocean. The sea is visible with some white foam from waves. In the distance, there are hills or mountains under a cloudy sky. A long, straight concrete or stone structure, possibly a pier or breakwater, extends from the beach into the water.

Muritai School

Coastal Inundation Adaptive Pathway Report

Adaptive Pathway: Muritai School

This adaptive pathway has been prepared for the Ministry of Education by WSP NZ Ltd. and is intended to advise possible adaptation pathways and give an indicative timeframe of these pathways in current and future climates.

This adaptive pathway document is required to be read with the "Guidance Document: Adaptive Pathway to Coastal Inundation" (WSP, 2023).

Site Overview

School Name	Muritai School
School ID	2920
MoE Region	Central South
Number of buildings on school site	9

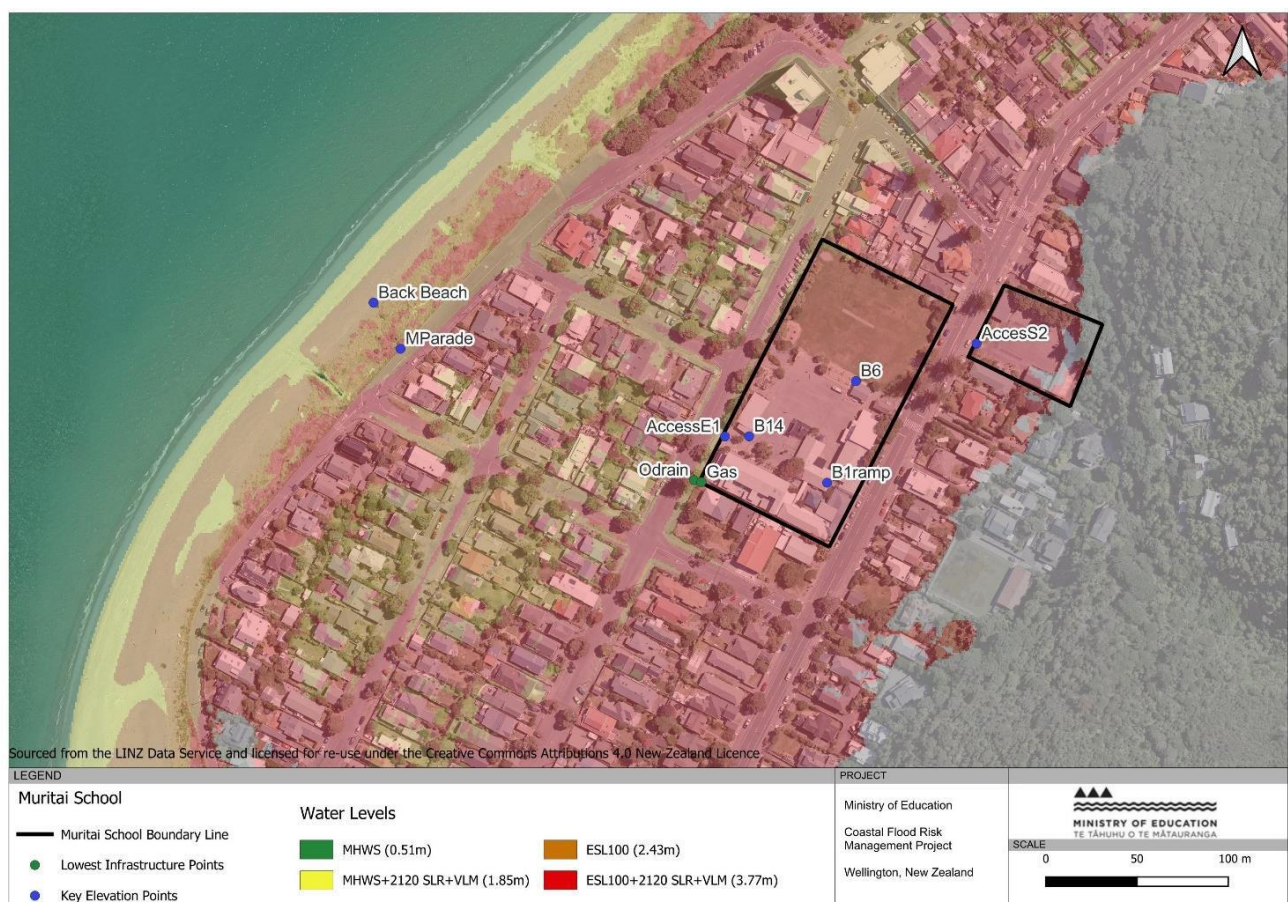


Figure 1 - Map of Muritai School with the indicative inundation zones based on land elevation from LiDAR.

Latitude	-41.291865
Longitude	174.89712
Community Setting	School grounds at same elevation as the community, therefore likely to have similar flooding issues from coastal waters. The surrounding water body is the Wellington Harbour / Te Whanganui-a-Tara Harbour.
Community Emergency Hub	Yes – Muritai School is a Community Emergency Hub
General Subsidence/Tectonics information	The Eastbourne area is subsiding at a current rate of -3.27 mm per year (Site 2489) (NZSeaRise Takiwa Programme, 2022).

Key Elevation Points

Note: Points are in NZVD 2016.

Access / Egress Points	Access along Oroua Street (AccessE1) = 2.48 m	Access along Muritai Road to Second Site (AccessS2) = 3.02 m
Lowest Finished Floor Levels	Block 14 (B14) = 2.75 m	Block 1 Ramp (B1Ramp) = 3.06 m and Block 6 (B6) = 3.06 m
Lowest Infrastructure levels	Gas Main (GAS) = 2.22 m	Stormwater drain by Oroua Street access to school (Odrain) = 2.45 m
Coastal Defences	Concrete Sea Wall (MPARADE) = 2.10 m at base of sea wall and 2.78 m at top of sea wall	Back beach at vegetation line (BACK BEACH) = 2.27 m

Water levels (current and future)

Note: Points are in NZVD 2016.

MHWS	0.51 m	ESL100 + 2050 SLR (+VLM) ¹	2.82 m
MHWS + 2120 SLR (+VLM) ²	1.85 m	ESL100 + 2070 SLR (+VLM) ³	3.04 m
ESL100	2.43 m	ESL100 + 2120 SLR (+VLM) ⁴	3.77 m

¹ This reference level is the ESL100 (2.43 m) with the 2050 (+VLM) SLR scenario (0.39 m) added to it.

² This reference level is the MHWS (0.51 m) with the 2120 (+VLM) SLR scenario (1.34 m) added to it.

³ This reference level is the ESL100 (2.43 m) with the 2070 (+VLM) SLR scenario (0.61 m) added to it.

⁴ This reference level is the ESL100 (2.43 m) with the 2120 (+VLM) SLR scenario (1.34 m) added to it.

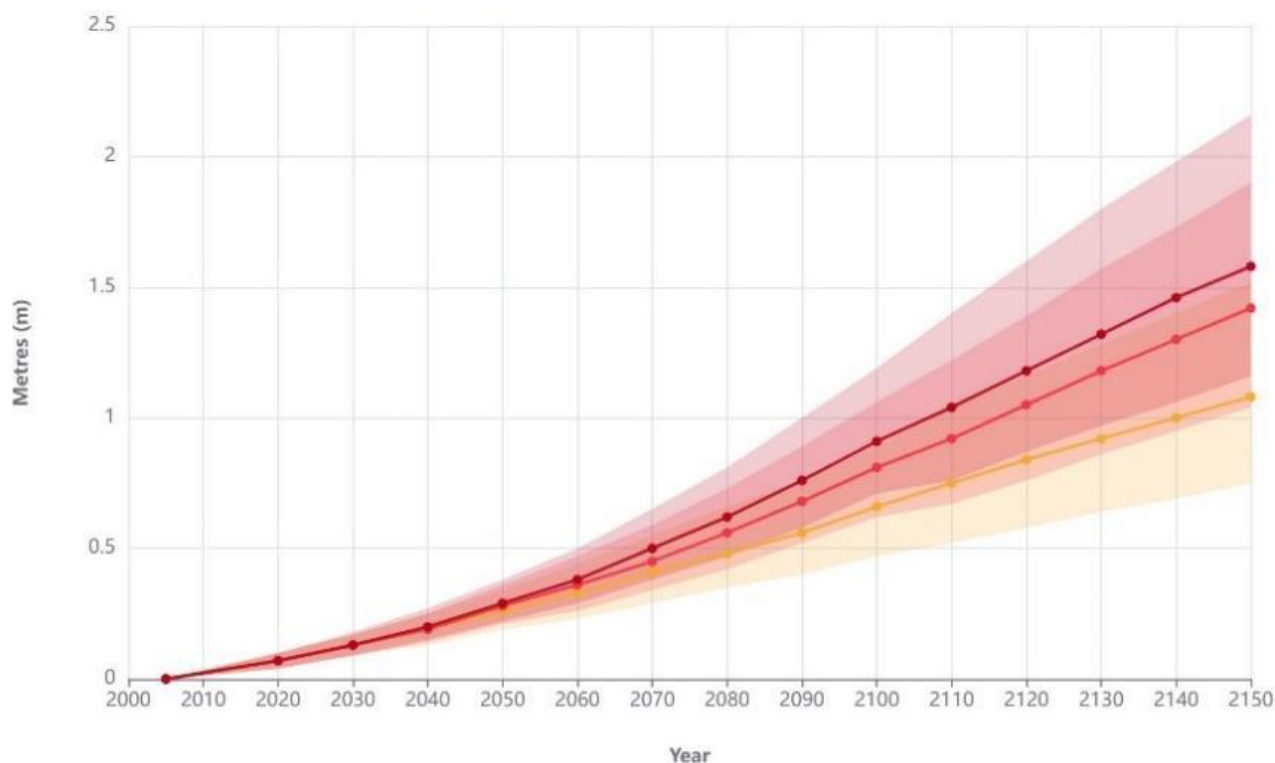


Figure 2 - Sea level rise (SLR) increments⁵ with vertical land movement under potential climate change scenarios (SSP2-4.5+VLM in orange, SSP3-7.0+VLM in red and SSP5-8.5 in deep red) and likely confidence intervals (faded colour blocks) (NZSeaRise Takiwa Programme, 2022). MfE (2022) recommends that the median (p50) SSP3-7.0+VLM is used.

Background / Summary of Coastal Inundation Risk

Local, district regional adaptation and infrastructure plans

The readily available relevant local, district and regional plans that provide guidance to understand and adapt to climate risks applicable to Muritai School are listed in Appendix C of this document and summarised below.

Greater Wellington Regional Council (GWRC) and Hutt City Council (HCC) are in the process of undertaking risk assessments and establishing adaptation plans for the area to ensure community resilience to climate change in the future. These adaptation plans will identify plans of potential adaptation actions to climate change and sea level rise that considers potential measures over time. However, there is no specific evidence (as of yet) in these plans if they may include works to the Eastbourne coastline adjacent to the school.

It is recommended that Muritai School and the Ministry of Education liaise with these parties to collaborate on appropriate mitigation/adaptation strategies for the school and its community and mana whenua.

⁵ Sea level rise increments added to MHWS and ESL 100 are the median values on the NZSeaRise programme charts as there are associated confidence intervals associated with each scenario.

Elevation Profile

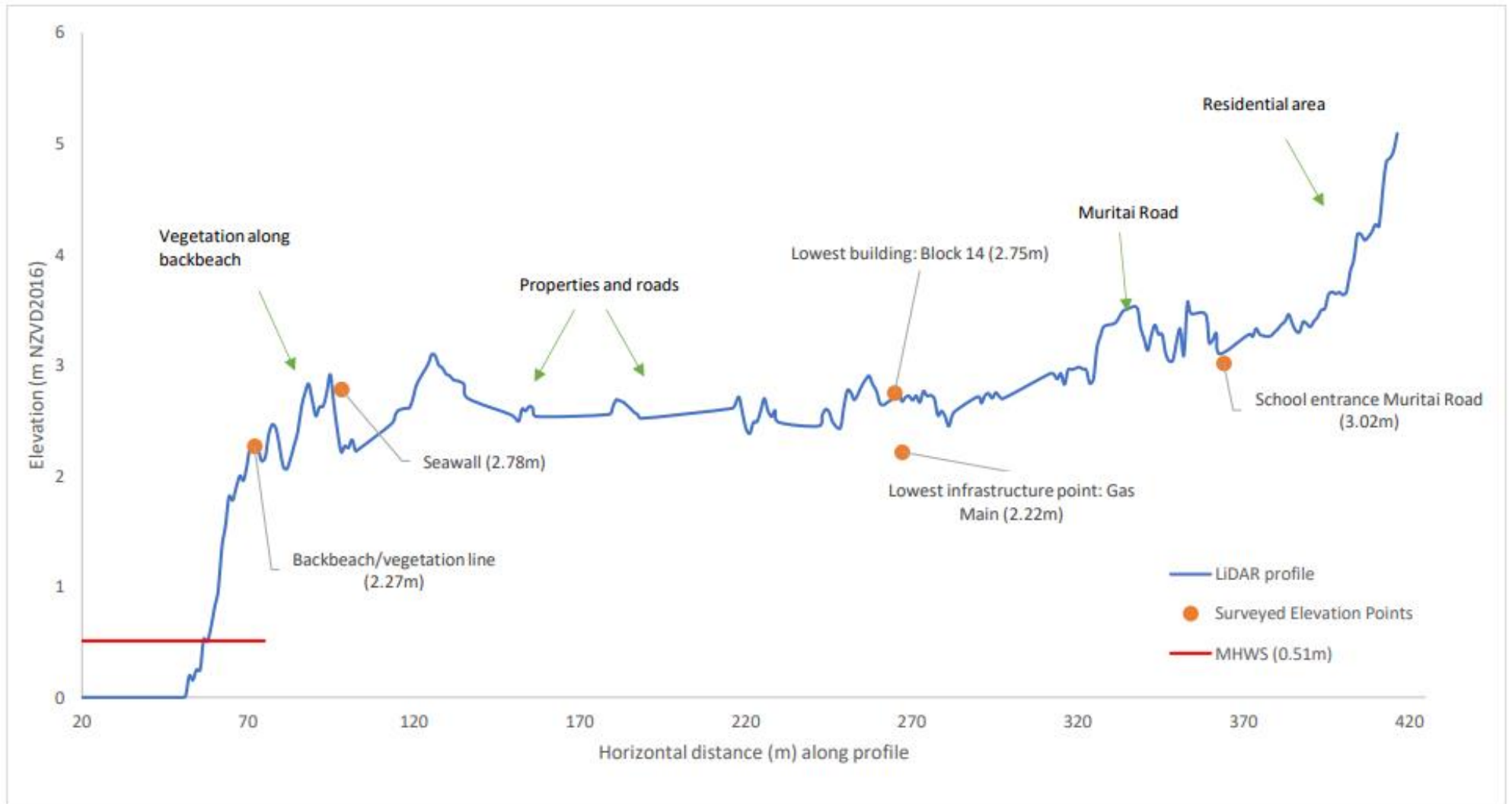


Figure3 – Indicative profile extracted from LiDAR (1m DEM) and surveyed elevation points on site.

Risk of Coastal Inundation (Past/Current/Future)

See Appendix B for further information.

Period	Vulnerability	
	MHWS	ESL100
Current	Low	Low-medium
Short-term (Present-2050)	-	Medium
Medium-term (2050-2070)	-	Medium
Long-term (2070-2120)	Low	High

Other Hazards

School anecdotal evidence

No recorded or anecdotal flooding from coastal inundation based on on-site conversations with the school principal and administration or limited search online.

Infrastructure

There is a small concrete wall located along the back beach of Eastbourne beach. The school is located approximately 150-200 m inland from the coast where a block of residential houses and streets are located between the coast and the school, behind the seawall.

Other types of flooding

Flooding from a combination of pluvial and stormwater sources to a depth of approximately 15 cm across parts of the school site frequently occurs under rain events. We noted a potential blockage of the drains on the school site and sumps on adjacent roads post rainfall event during site visit in August 2022 was observed.

No anecdotal or recorded fluvial flooding.

Erosion

No significant evidence of erosion of coastline during on-site surveys. The vegetated dune field may suggest that the coast is relatively stable. More detailed investigations into the long-term erosion trends of the stretch of coastline is required to make an accurate judgement on the erosion potential of the beach, particularly associated with increasing sea levels.

Preferred Adaptive Pathway


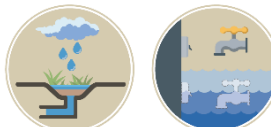
The preferred adaptive pathway for Muritai School has been suggested due to its practicality, taking the school's current vulnerability into consideration as well as any future increase in vulnerability with predicted rises in sea level. The pathway anticipates the possibility of future community-level conversations and activities that the Ministry of Education and school should be aware of and consider contributing to as well.

The short-term pathway for Muritai School should be considered as it should help address the small-scale flooding issues, through relatively minor and cost-effective options. In the future, the long-term pathway for Muritai School could be to establish flood exclusion defence structures (temporary or permanent) around the school, which will allow the school site to continue to be used.



The preferred adaptive pathway is subject to monitoring of the site and community, and monitoring of how the preferred pathway responds to sea level rise by the Ministry of Education. As it is adaptive, it also suggests/assumes that the Ministry of Education will review the pathway options at regular intervals (*at least* every 10 years), before significant changes to school site, or, after a coastal inundation event.

The preferred adaptive pathway suggested for Muritai School considers the coastal inundation (flooding) risk and does not consider/include the impact of pluvial and fluvial inundation, the erosion of the coastal shoreline, the demographic changes associated with the school such as the school roles and the forthcoming asset management interventions to enhance current school assets.



Preferred Adaptive Pathway – Short Term (Present Day-2050)

Pathway Approach	Accommodate	
Preferred Pathway	<p>Consider stormwater improvements to the school site such as introducing flap and non-return valves. Poor maintenance of on-site infrastructure also contributes to these incidents, and we recommend that these activities are enhanced.</p> <p>Consider raising the site meter infrastructure for gas.</p>	
Trigger Points	Stormwater improvements have already been triggered and action for these improvements should be considered now to reduce existing site level flooding (other sources).	

Preferred Adaptive Pathway – Medium Term (2050-2070)

Pathway Approach	Accommodate	
Preferred Pathway	Consider the introduction of the use of demountable flood barriers during extreme sea levels along the western boundary of the school site which could be vulnerable to coastal inundation in the medium term.	
Trigger Points	The introduction of the use of demountable flood barriers could be triggered when the road and the community between the school and the coast experience coastal inundation. An indicative timeframe for when this could occur is from 2050.	

Preferred Adaptive Pathway – Long Term (2070-2120)

Pathway Approach	Protect	
Preferred Pathway	Consider building of flood exclusion defences around the western side of the school site allowing for continued community access to the school site.	
Trigger Points	The building of the flood exclusion defences (temporary or permanent) could be triggered when coastal water causes flooding at the school site. An indicative timeframe for when this could occur is from 2070.	

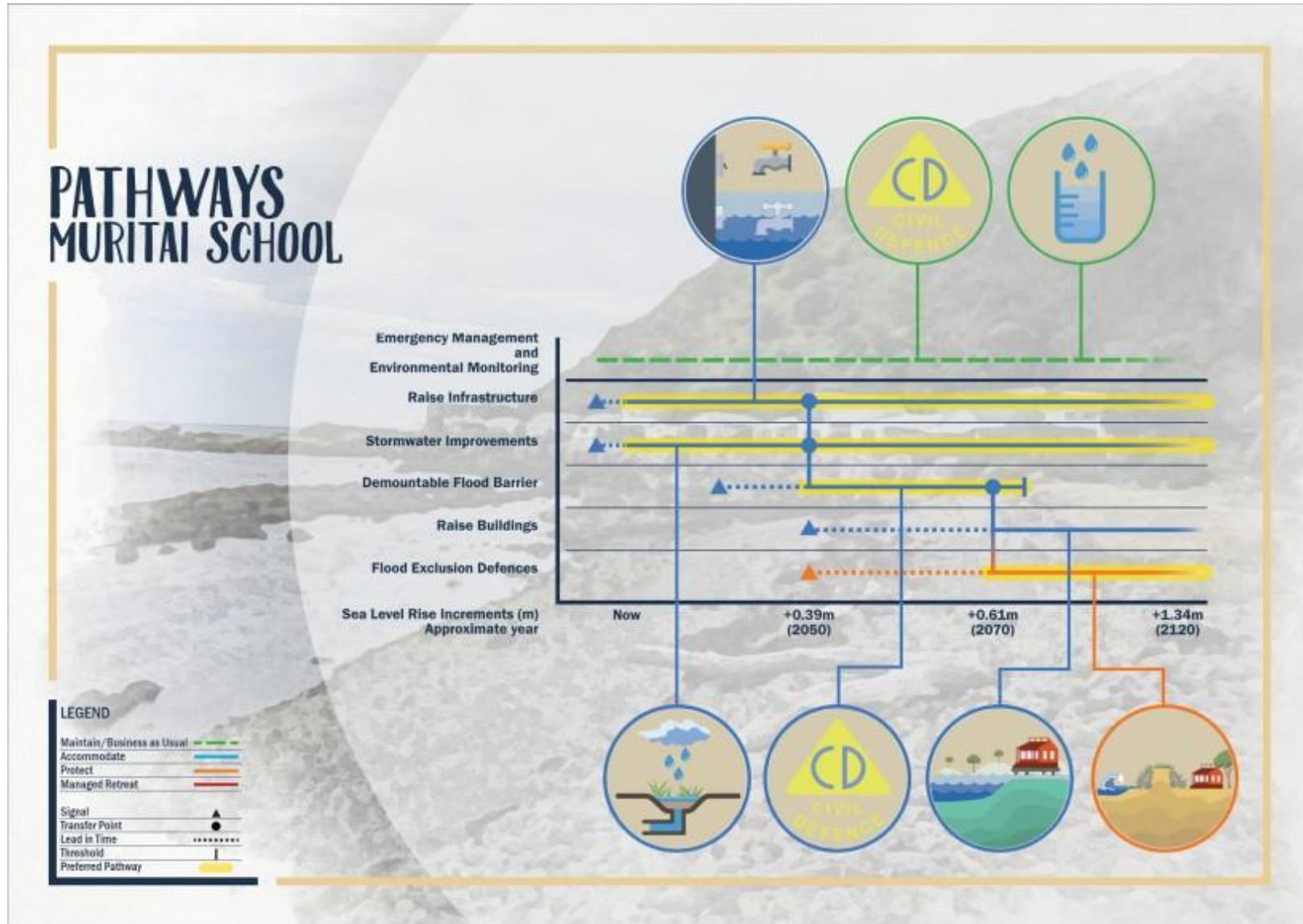










Figure 4 – Coastal Inundation Adaptation Pathway infographic for Muritai School.

Appendix A: Adaptive Pathways

Short-list Options Considered

Note: Refer to Appendix A in the Guidance Document (WSP, 2023)

	Guidance document reference	Options considered
Short Term	A & B & C   	All current coastal inundation management activities continue. Maintain existing infrastructure and continue current emergency management and environmental monitoring activities to existing level of service.
	D 	Consider stormwater improvements on the school site (to reduce current exposure to other flooding hazards to the site).
	D 	Consider raising infrastructure at risk.
Medium Term	G 	Consider implementing demountable flood barriers.
Long Term	M 	Consider building flood exclusion defences around the school site allowing for continued community access.
	E 	Consider raising the finished floor levels of all buildings.

Appendix B: Risk of Coastal Inundation (Past/Current/Future)

Current Vulnerability to MHWS:

Muritai School has a low vulnerability to coastal inundation under current MHWS (0.51 m). No buildings or infrastructure surveyed are vulnerable to coastal inundation as they are at an elevation above the referenced level for MHWS.

Long Term (2070-2120) Vulnerability to MHWS with SLR:

Muritai School has a low vulnerability to coastal inundation under MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.85 m). No buildings or infrastructure surveyed are vulnerable to coastal inundation as they are at an elevation above the referenced level for this predicted event.

Current Vulnerability to ESL100:

Muritai School has a low-medium vulnerability to coastal inundation under the current day ESL100 scenario (2.43 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event are:

- Gas main infrastructure (2.22 m).

The current day ESL100 (2.43 m) is lower than the elevation of the top of the sea wall defence (2.78 m), therefore the potential for coastal inundation due from overtopping is low.

Short term (Present Day-2050) vulnerability to ESL100 with SLR:

Muritai School has a medium vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2050 SLR scenario (2.82 m). The vulnerable buildings and infrastructure surveyed are below the referenced level for this predicted event:

- All infrastructure surveyed
- FFL of Block 14 (2.75 m)
- School access along Oroua Street (2.48 m)

Medium term (2050-2070) Vulnerability to ESL100 with SLR:

Muritai School has a medium vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (3.04 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed
- FFL of Block 14 (2.75 m)
- School access along Oroua Street (2.48 m)
- School access to both areas of the school site along Muritai Road (3.02 m)

Long term (2070-2120) Vulnerability to ESL100 with SLR:

Muritai School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (3.77 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed
- All FFL's of buildings surveyed (except for Block 1 back door and Block 7)
- School access along Oroua Street (2.48 m)
- School access to both areas of the school site along Muritai Road (3.02 m)

Appendix C: Local, district and regional adaptation and infrastructure plans

National Adaptation Plan (MfE):

National Adaptation Plan outlines a programme of work to support communities to better understand the climate impacts that affect them and adapt to build their resilience.

Waka Kotahi New Zealand Transport Agency

Waka Kotahi New Zealand Transport Agency (Waka Kotahi) release 'Tiro Rangi Climate Adaptation Plan' in December 2022. To ensure that the land transport system is resilient with climate change, Waka Kotahi in alignment with the National Adaptation Plan adaptation framework (avoid, protect, accommodate and retreat), will use a combination of these categories to effectively adapt in different locations and over different timescales. These adaptation strategies will be built into long-term planning to avoid ongoing expensive repairs, disruption and declining levels of service (date accessed 18/04/2023).

Hutt City Council

Hutt City Council (HCC) are building their knowledge about the effects of climate change. HCC jointly commissioned the 2019 report Preparing Coastal Communities for Climate Change, which identified the coastal areas of Lower Hutt that are most vulnerable to climate change, sea level rise and natural hazards (date accessed 03/04/2023). The area of Eastbourne was found to be the third most vulnerable unit within the Hutt City as the area includes low-lying settlement which is reliant on a single road in and out. Under this assessment Eastbourne is highlighted as having high vulnerability in terms of emergency management, Three Waters infrastructure, and high risk of coastal erosion.

HCC district plan (currently under review) will detail information from flooding maps and sea-level rise modelling, to ensure that future developments take account of flood and sea level rise risks and don't increase the risks to existing developments/communities, to map out sustainable options/pathways for the future (date accessed 03/04/2023).

HCC propose upgrades to the Three Waters Infrastructure. The effects of higher rainfall and other climate change effects are incorporated in the design standards and eventual stormwater mitigation solutions. HCC are also increasing the resilience of the assets that are at risk of inundation due to the impact of sea-level rise (date accessed 03/04/2023).

A regional risk assessment for key climate change impacts is being developed which will underpin the subsequent regional approach to climate change impacts and HCC's work focused on its communities adapting to climate impacts (date accessed 03/04/2023).

Tupua Horo Nuku Eastern Bays shared path plan is proposed to construct new seawalls along the Eastbourne coastline and is anticipated to provide improved protection from the coast; however, these works do not extend along the stretch of coastline adjacent to the Eastbourne township where Muritai School is located (date accessed 03/04/2023). These works will have a positive impact on improved access to the area, however, do not provide protection to the coast adjacent to the school. The Ministry of Education should continue to monitor and review the plan if it is adapted or extended south.

Eastern Bays Climate Response Network Group

Eastern Bays Climate Response Network Group helps the Eastbourne community, understand sea level rise (and land subsidence) predictions and consequences, risk

assessment and insurance implications, regional and local transport infrastructure effects and responses, and local government and planning preparations.

A group from the Eastern Bays Climate Response Network met with the Muritai School principal, to talk about how they could work together to protect and restore the local environment. They plan to form a committee in the new year with representatives from the staff, students, whānau, and wider community, to champion environmental initiatives at the school.

Eastbourne Business Climate Response Survey aimed to measure how local businesses may be addressing climate change. The aim was to publicise and raise awareness of how businesses are and can respond (currently ongoing, accessed 11/04/2023). The Ministry of Education should work with local businesses once the survey is completed to identify how their response may have an impact on Muritai School.

Glossary and Acronyms

Key term	Definition
Adaptation	The process taken to adjust to the impacts and risks of coastal inundation.
Adaptation approaches and options	Compendium of five approaches of physical climate change adaptation and resilience measures relevant for coastal inundation across Aotearoa New Zealand, which can help to support the Ministry of Education address the climate change impacts to schools from Coastal Inundation.
Annual exceedance probability	Annual Exceedance Probability (AEP) is the probability of an event occurring in any given year. i.e. a 1% AEP means there is a 1% chance in any given year of the event occurring. This means that on average 1 event of this size will occur every 100 years.
Climate change	Large-scale, long-term shifts in the planet's weather patterns and average temperatures
Climate change impacts	The consequences of climate change, both experienced and expected, for natural and human systems and environments.
Coastal inundation adaptation approaches/options	Practical things that can be done to adjust to, prepare for, respond to, and recover from coastal inundation impacts and risks.
Coastal inundation threshold/ reference water level event	Predicted water levels under current and future climate using the current day MHWS and ESL100 at each school location with SLR+VLM in 2050, 2070, and 2120 added.
Coastal inundation vulnerability	Identification of resources at risk from coastal inundation.
Extreme Sea Level (ESL100)	Extreme sea level from a storm which has a statistical 1% chance of being exceeded in any given year based on present day conditions.
Finished floor levels (FFL)	Elevation level of the ground-floor of a building
Mean High Water Spring (MHWS)	The long term average of the highest high- tide that water levels reach at the time of spring tides.
Resilience	Capacity to prepare for, respond to, and recover from climate impacts and risks while incurring minimal damage to wellbeing, the economy, and the environment.
Shared Socioeconomic Pathways (SSP)	Range of future climate change pathways determined by a series of socio- economic assumptions that drive future greenhouse gas emissions.
Signal/Trigger	A point in time that allows any change that occurs to be monitored and to have a point on which to adapt. Signals/triggers highlight impending changes in risk.
SSP3-7.0	Climate change scenario under medium-high future emissions and warming (3°C warmer world). This scenario was used in the CIAPs.
Vertical Land Movement (VLM)	Rate per year (mm) by which the land is subsiding or uplifting.