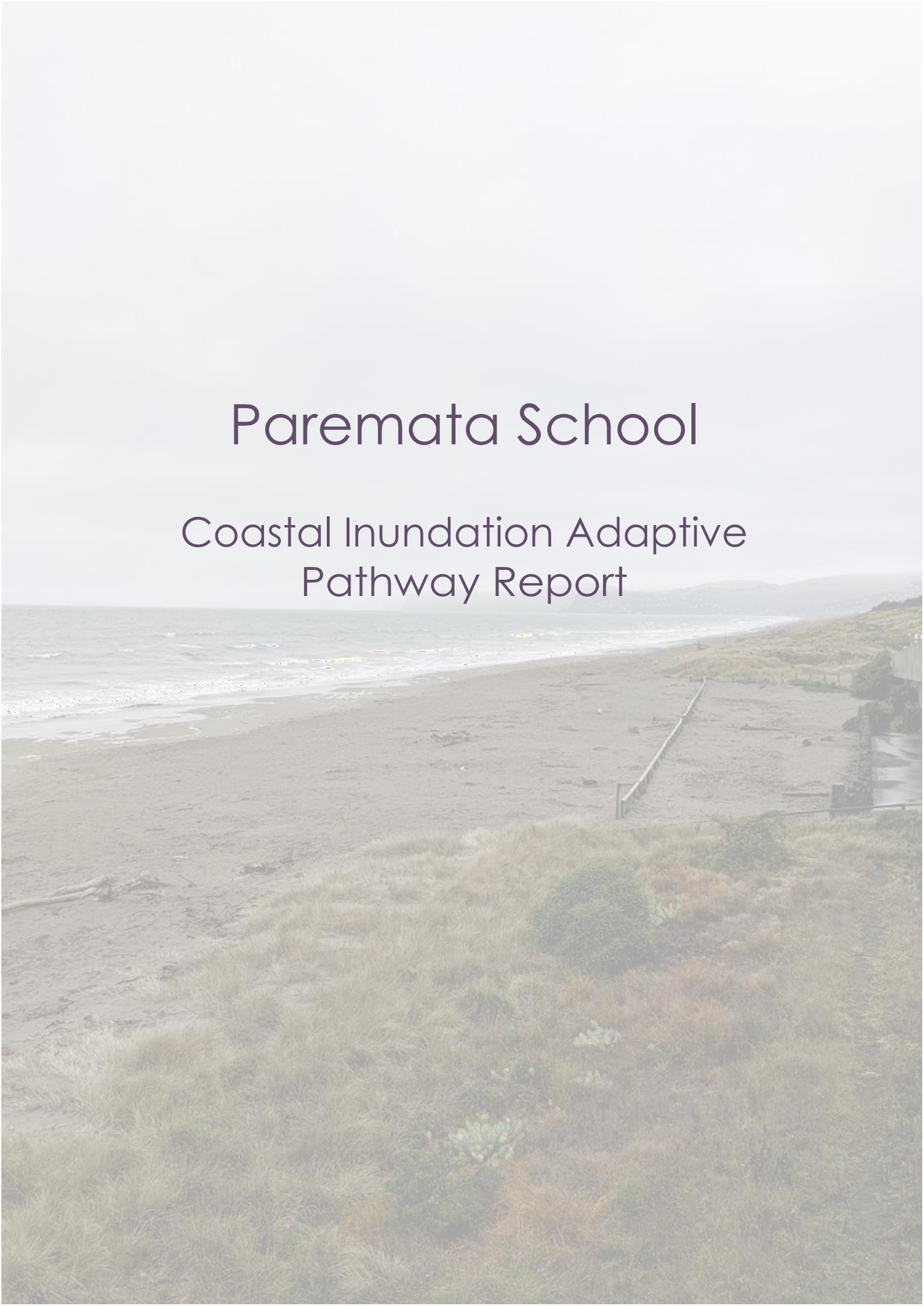
Paremata School

Coastal Inundation Adaptive Pathway Report



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Adaptive Pathway: Paremata School

This adaptive pathway report 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	Paremata School
School ID	2950
MoE Region	Central South
Number of buildings on school site	8

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

Latitude	-41.106972
Longitude	174.86826
Community Setting	School grounds are at a lower elevation than the surrounding community, therefore the school is likely to experience more significant impacts from coastal inundation. Surrounding water body is the Porirua Harbour / Te Awarua-o-Porirua Harbour.
Community Emergency Hub	No – Paremata School is not a Community Emergency Hub.
General Subsidence/Tectonics information	The Paremata area is subsiding at a current rate of -2.03 mm per year (Site 2567) (NZSeaRise Takiwa Programme, 2022).

Key Elevation Points

Note: Points are in NZVD 2016.

Access / Egress Points	Pedestrian Access via Paremata Crescent (Foot Access 1) – 2.45 m	Pedestrian Access at the cul de sac of Station Road (Foot Access 2) – 2.19 m
	Vehicle Access/egress via Station Road (Vehicle Access) – 1.94 m	Pedestrian Access 3 (B2.2) – 1.63 m
Lowest Finished Floor Levels	Block 1 (B1.3) – 1.83 m	Block 1 (B1.4) – 1.84 m
Lowest Infrastructure levels	Stormwater Grate Drain (SW.court2) – 1.30 m	Stormwater Grate Drain (SW.Court) – 1.37 m
Coastal Defences	State Highway 59 (based on LiDAR) – 3.05 m	

Water Levels (current and future)

Note: Points are in NZVD 2016.

MHWS	0.51 m	ESL100 + 2050 SLR *(+VLM)*[1]	1.84 m
MHWS + 2120 SLR (+VLM)[2]	1.69 m	ESL100 + 2070 SLR *(+VLM)*[3]	2.03 m
ESL100	1.51 m	ESL100 + 2120 SLR *(+VLM)*[4]	2.69 m

[1] This reference level is the ESL100 (1.51 m) with the 2050 (+VLM) SLR scenario (0.33 m) added to it.
[2] This reference level is the MHWS (0.51 m) with the 2120 (+VLM) SLR scenario (1.18 m) added to it.
[3] This reference level is the ESL100 (1.51 m) with the 2070 (+VLM) SLR scenario (0.52 m) added to it.
[4] This reference level is the ESL100 (1.51 m) with the 2120 (+VLM) SLR scenario (1.18 m) added to it.

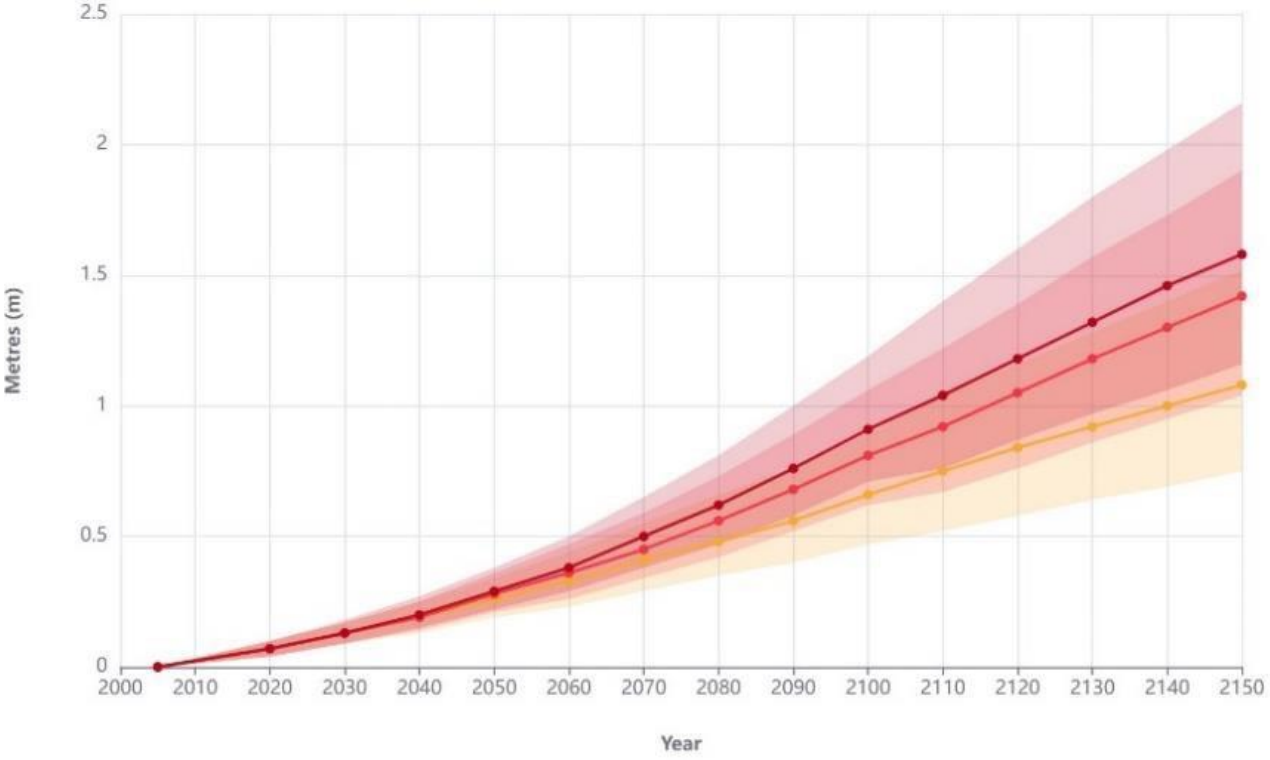

Figure 2 - Sea level rise (SLR) increments[5] with vertical land movement under potential climate change scenarios (SSP2-4.5+VLM in orange, SSP3-7.0+VLM in red and SSP5-8.5 in deep red) and likely confidence intervals (faded colour blocks) (NZSeaRise Takiwa Programme, 2022). MfE (2022) recommends that 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 Paremata School, are listed in Appendix C of this document and summarised below.

Greater Wellington Regional Council (GWRC) and Porirua City Council (PCC) 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. Multiple reports have been commissioned from the city council, to understand the level of exposure and the level of risk of the area to coastal hazards into the future. Waka Kotahi, who are responsible for the State highway, and KiwiRail, who are responsible for the railway located between Paremata School and the inner Porirua Harbour, outline specific adaptation strategies they will build into long-term asset planning. However, there is no specific evidence (as of yet) in these plans if they may include works to inner harbour coastline adjacent to the school.

It is recommended that Paremata 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 ESL100 are the median values on the NZSeaRise programme charts as there are associated confidence intervals associated with each scenario.

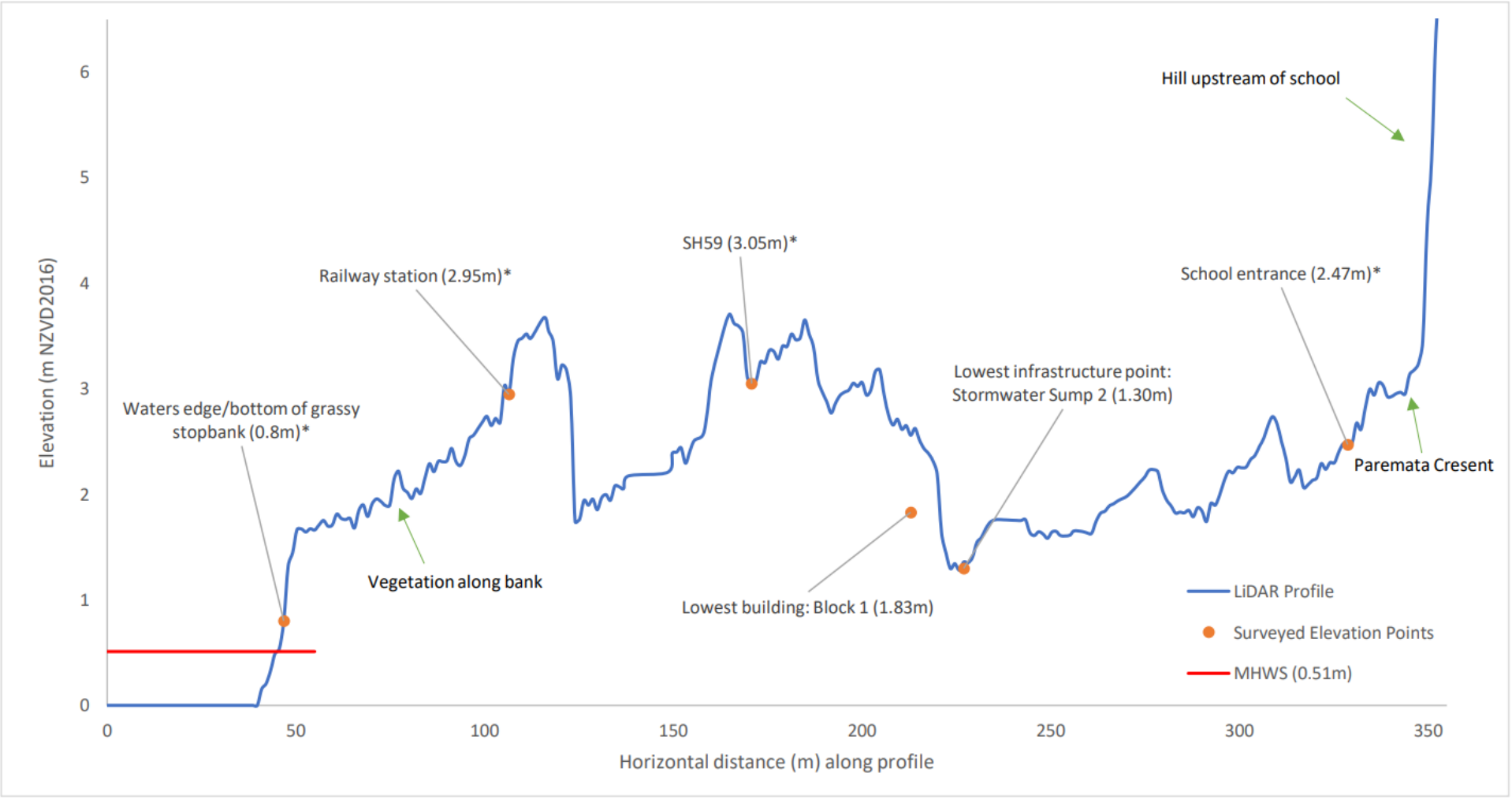

Figure 3 – Indicative profile extracted from LiDAR (1m DEM) and surveyed elevation points on site

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Risk of Coastal Inundation (Past/Current/Future)

See Appendix B for further information.

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

Other Hazards

Anecdotal evidence

No recorded or anecdotal flooding from coastal inundation due to the direct overtopping of waves, based on on-site conversations with the school principal and administration or limited search online.

During times of high tide, surface water from rainfall is unable to drain effectively due to the low site elevation in relation to mean sea level, therefore when combined with heavy rainfall, flooding occurs on site.

Infrastructure

State Highway 59 and the western Wellington Railway is located between the school and the Porirua Harbour coastline.

Other types of flooding

Paremata School has experienced flooding due to surface water runoff from the surrounding catchment. The school is at a lower elevation than the surrounding area, therefore water drains to the school site.

Paremata School has also experienced flooding due to the combination of stormwater and wastewater. Wastewater manholes exceed capacity and lift open when infiltrated with stormwater, flooding the school to approximately 15-20 cm. Wastewater manholes on site have leaked wastewater on the site due to exceeding capacity. It is recommended that the Ministry of Education and Paremata School liaise with the asset owners of the wastewater network, to work towards resolving this issue and the potential acute human health effects that could result from wastewater flooding on the school site.

Flooding from the stormwater drain located along the southern boundary of the school occurs due to poor drainage and blockages, causing internal flooding to neighbouring properties.

Erosion

No significant evidence of erosion of harbour coastline during on-site surveys. 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 coastline, particularly associated with increasing sea levels.

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Preferred Adaptive Pathway

The preferred adaptive pathway for Paremata 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 Paremata School should be considered to help address the small-scale flooding issues, through relatively minor and cost-effective options. In the future, the long-term pathway for Paremata School could be to successfully manage retreat from the site to a new site, to ensure that the school is out of all flood hazard zones and can continue to be used without any major flooding risks.

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 Paremata 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-2050)

Pathway Approach	Accommodate	
Preferred Pathway	Consider stormwater infrastructure 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.	
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 major stormwater improvements on the school site such as exploring the design of stormwater retention options, to address runoff from surrounding catchment and allow for the water to recede following high tides, and a pump station to get water off the school site	
Trigger Points	Major stormwater improvements could be triggered when the minor stormwater improvements are no longer capable of sustaining drainage of the site. An indicative timeframe for when this trigger could occur is from 2040.	

Preferred Adaptive Pathway – Long Term (2070-2120)

Pathway Approach	Managed Retreat	
Preferred Pathway	Consider the managed retreat of the school to a new school site outside of all flood and coastal hazard zones.	
Trigger Points	The managed retreat of the school could be triggered when the stormwater retention improvements and pump station no longer provide sufficient drainage of stormwater on the school site. An indicative timeframe for when this could occur is from 2050.	

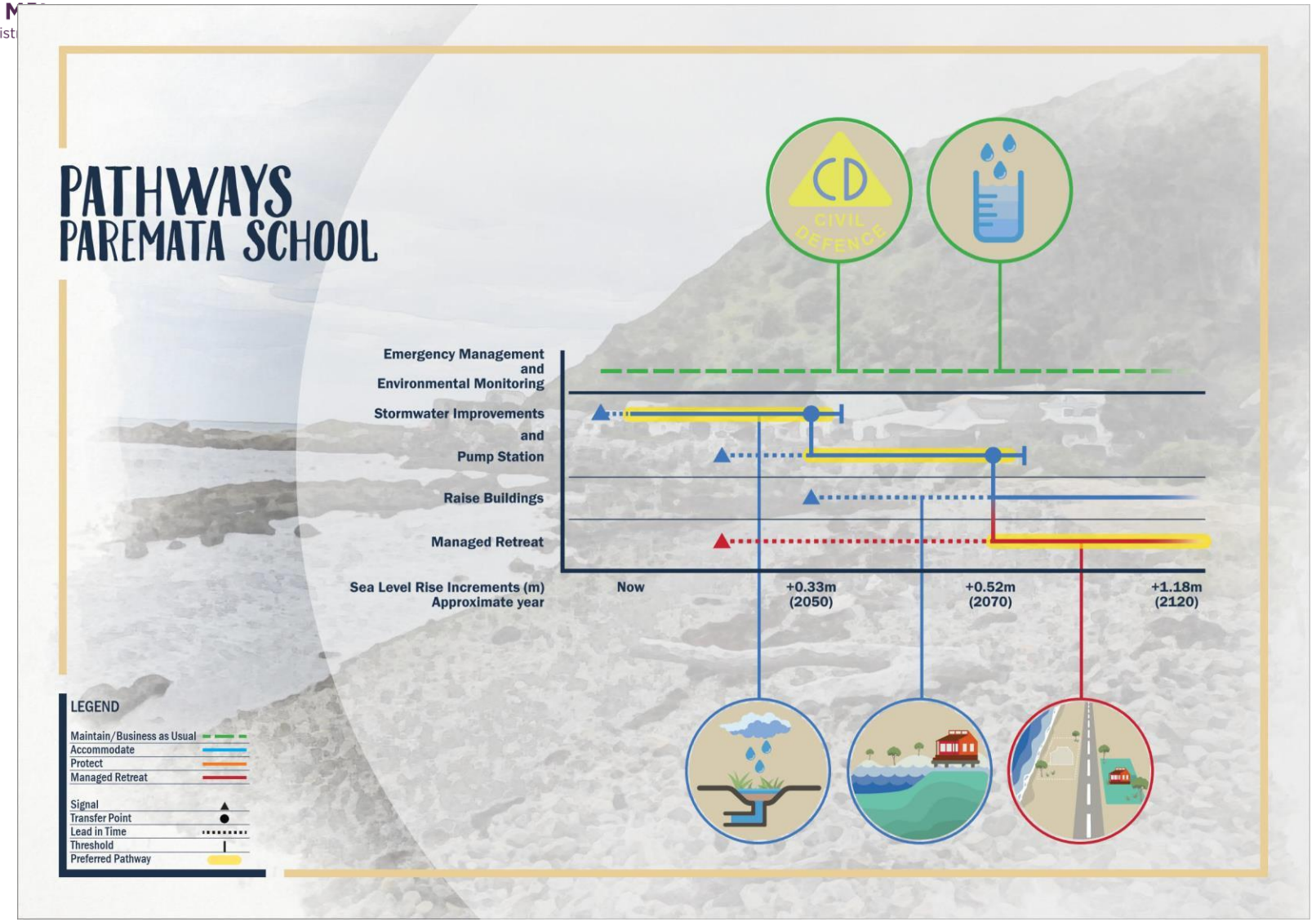

Figure 4 – Coastal Inundation Adaptation Pathway infographic for Paremata School

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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 such as cleaning drains and continue current emergency management and environmental monitoring activities to existing level of service.
	D 	Consider stormwater improvements on the school site such as non-return flap valves (to reduce current exposure to other flooding hazards to the site and impacts of coastal inundation)
Medium Term	D 	Consider major stormwater improvements on the school site such as consider exploring the design of stormwater retention options to address runoff from surrounding catchment and allow for the water to recede following high tides and a pump station to get water off the school site
Long Term	E 	Consider raising the finished floor levels of all buildings.
	O 	Consider the managed retreat of the school to a new school site outside of all flood and coastal hazard zones.

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Appendix B: Risk of coastal inundation (Past/Current/Future)

Current Vulnerability to MHWS:

Paremata 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:

Paremata School has a medium vulnerability to coastal inundation under MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.69 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this projected event are:

- Stormwater infrastructure along southern boundary and on the school court of the school site (SW.court1 - 1.37 m and SW.court2 - 1.30 m).
- Pedestrian access 3 (B2.2 – 1.63 m).

The current day MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.69 m) is lower than the elevation of SH 59 (3.05 m based on LiDAR), therefore potential for coastal inundation from overtopping is low.

Current vulnerability to ESL100:

Paremata School has a medium vulnerability to coastal inundation under the current day ESL100 scenario (1.51 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event are:

- Stormwater infrastructure along southern boundary and on the school court of the school site (SW.court1- 1.37 m and SW.court2 1.30 m).

The current day ESL100 (1.51 m) is lower than the elevation of SH 59 (3.05 m based on LiDAR), therefore potential for coastal inundation from overtopping is low. Despite the potential of coastal overtopping is low, the school still has a medium vulnerability due to the decrease in ability of the water to recede during extreme sea levels.

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

Paremata School has a medium vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2050 SLR scenario (1.84 m). The vulnerable buildings and infrastructure surveyed are below the referenced level for this predicted event:

- Stormwater infrastructure along southern boundary and on the school court of the school site (SW.court1- 1.37 m and SW.court2 1.30 m).
- FFL of Block 1 west.
- Pedestrian access 3 (B2.2 – 1.63 m).

The ESL100 with the SSP3-7.0+VLM 2050 SLR scenario (1.84 m) is lower than the elevation of SH 59 (3.05 m based on LiDAR), therefore potential for coastal inundation from overtopping is low. Despite the potential of coastal overtopping is low, the school still has a medium vulnerability due to the decrease in ability of the water to recede with increased sea level rise.

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

Paremata School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (2.03 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- Stormwater infrastructure along southern boundary and on the school court of the school site (SW.court1- 1.37 m and SW.court2 1.30 m)

- All FFL's of buildings surveyed (except for Block 8 south, Block 10, Block 3 south and Block 4 north)
- Pedestrian access 3 (B2.2 – 1.63 m)
- Vehicle access/egress via station Road (1.94 m)

The ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (2.03 m) is lower than the elevation of SH 59 (3.05 m based on LiDAR), therefore potential for coastal inundation from overtopping is low. Despite the potential of coastal overtopping is low, the school still has a high vulnerability due to the decrease in ability of the water to recede with increased sea level rise.

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

Paremata School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (2.69 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed (except for power generator)
- All FFL's of buildings surveyed (except for Block 4 north)
- All access points surveyed

The ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (2.69 m) is lower than the elevation of SH 59 (3.05 m based on LiDAR), therefore potential for coastal inundation from overtopping is low. Despite the potential of coastal overtopping is low, the school still has a high vulnerability due to the decrease in ability of the water to recede with increased sea level rise.

All current and predicted reference levels are below the elevation of the SH 59 (3.05 m based on LiDAR), therefore Paremata School is unlikely to experience coastal inundation from the overtopping of waves. Flooding from coastal inundation is likely to occur during hightide as this will result in poor drainage of stormwater off site.

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

MfE's National Adaptation Plan:

The 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).

KiwiRail

KiwiRail have identified through their Sustainability Strategy 2022-2025 that they have an objective targeted to improve their understanding of climate change impacts, and that the adaptation requirements and management plans are in place for existing assets and new capital projects.

Porirua City Council

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

PCC have a Climate Change Strategy to help prepare its communities and businesses to adapt to the impacts of climate change. To understand and prepare for these impacts, PCC are in the process of identifying the risks and opportunities through completing risk assessments that quantify what and where the risks are, and are developing a framework that monitors and reports on the costs of events, to provide an evidence base for adapting to the impacts. Within the next two years PCC are proposing to engage with coastal communities to plan and prepare for sea level rise, to ensure that key assets and infrastructure are resilient to same.

As part of Porirua City Council's Climate Change Strategy, key approaches to coastal adaptation for existing communities are outlined. These align with the National Adaptation Plan adaptation framework (avoid, protect, accommodate and retreat). For future development they will accommodate via regulatory instruments such as the Proposed District Plan, they will apply the retreat approach to prevent new development through risk-informed planning, and allow development to take place on the condition that it will be abandoned if necessary.

PCC are building their knowledge about the effects of climate change. PCC commissioned a coastal hazard report completed in 2019 (FOCUS, 2019) called 'Porirua City Coastal Hazard Assessment -Draft' (accessed 21/04/2023) to identify areas vulnerable to coastal erosion and inundation around the coast of the district over the next 100 years, and to provide broad management recommendations to assist with developing provisions for the District Plan review. This report identified that the area that includes where Paremata School is located is vulnerable to coastal inundation with 1.0m of sea level rise.

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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 Level (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.