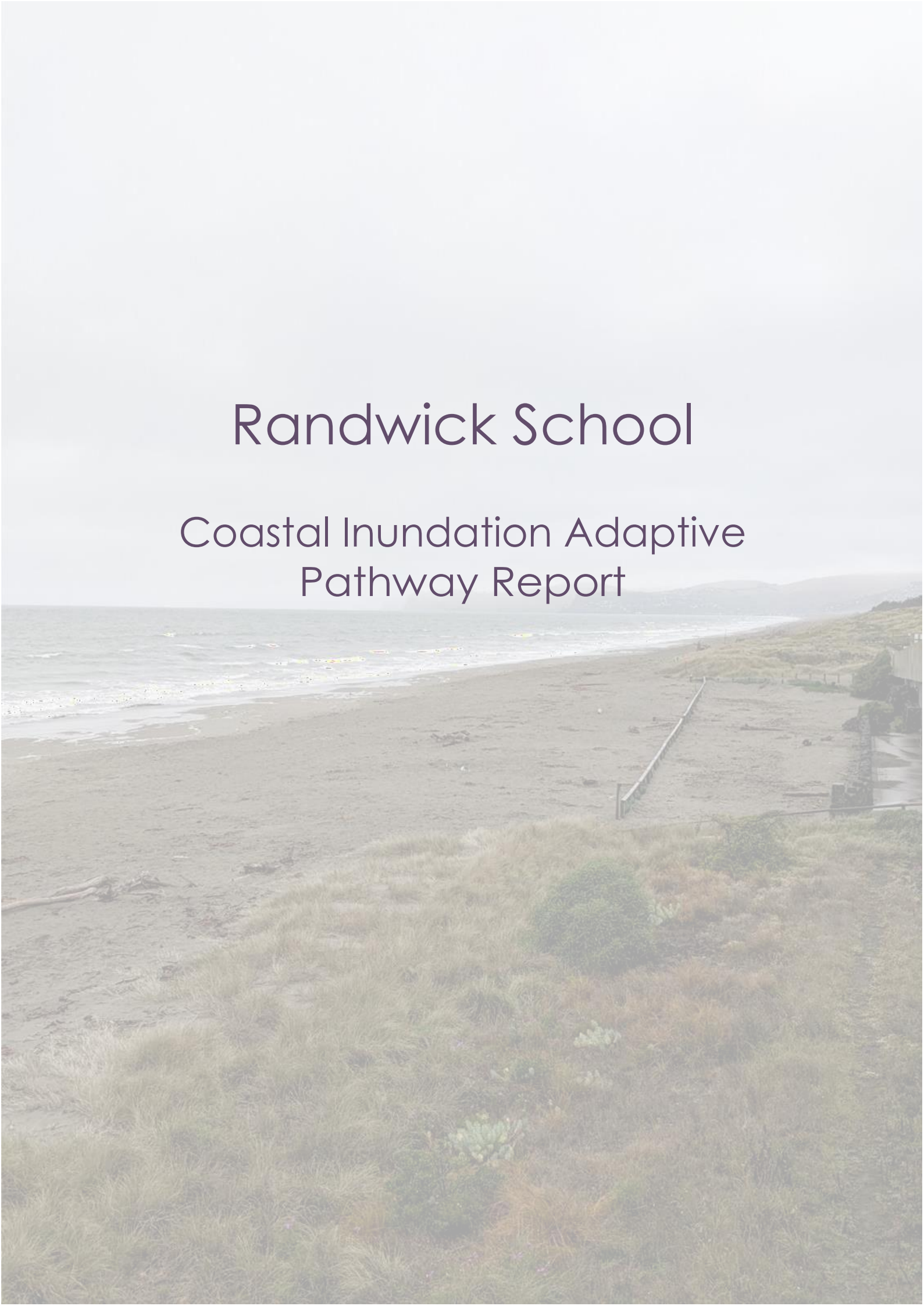
Randwick School

Coastal Inundation Adaptive Pathway Report



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Adaptive Pathway: Randwick 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	Randwick School
School ID	2969
MoE Region	Central South
Number of buildings on school site	4

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

Latitude	-41.229325
Longitude	174.904637
Community Setting	School grounds at same elevation as the community, therefore likely to have similar flooding issues from the coast and Te Awa Kairangi / Hutt River. The surrounding water bodies are the Te Whanganui-a-Tara / Wellington harbour and Te Awa Kairangi / Hutt River.
Community Emergency Hub	Yes – Randwick School is a Community Emergency Hub
General Subsidence/Tectonics information	The Randwick area is subsiding at a current rate of -3.81 mm per year (Site 2493) (NZSeaRise Takiwa Programme, 2022).

Key Elevation Points

Note: Points are in NZVD 2016.

Access / Egress Points	Vehicle access (R.Vehicle) – 1.23 m	Pedestrian Access Gate (R.AccessFoot) – 1.27 m
Lowest Finished Floor Levels	Block G south-west (R.G2) – 1.55 m	Block G south-east (R.G1) – 1.71 m
Lowest Infrastructure levels	Heat pump Block E (R.Eheatpump) – 1.56 m	Caretakers Shed (R.caretaker) - 1.67 m
Coastal Defences	Hutt River stop bank crest adjacent to school (R.SB2) – 3.72 m	Stop bank crest near mouth of Hutt River (R.SB1) – 2.97 m

Water Levels (current and future)

Note: Points are in NZVD 2016.

MHWS	0.51 m	ESL100 + 2050 SLR *(+VLM)*[1]	2.86 m
MHWS + 2120 SLR (+VLM)[2]	1.91 m	ESL100 + 2070 SLR *(+VLM)*[3]	3.10 m
ESL100	2.45 m	ESL100 + 2120 SLR *(+VLM)*[4]	3.85 m

[1] This reference level is the ESL100 (2.45 m) with the 2050 (+VLM) SLR scenario (0.41 m) added to it.
[2] This reference level is the MHWS (0.51 m) with the 2120 (+VLM) SLR scenario (1.40 m) added to it.
[3] This reference level is the ESL100 (2.45 m) with the 2070 (+VLM) SLR scenario (0.65 m) added to it.
[4] This reference level is the ESL100 (2.45 m) with the 2120 (+VLM) SLR scenario (1.40 m) added to it.

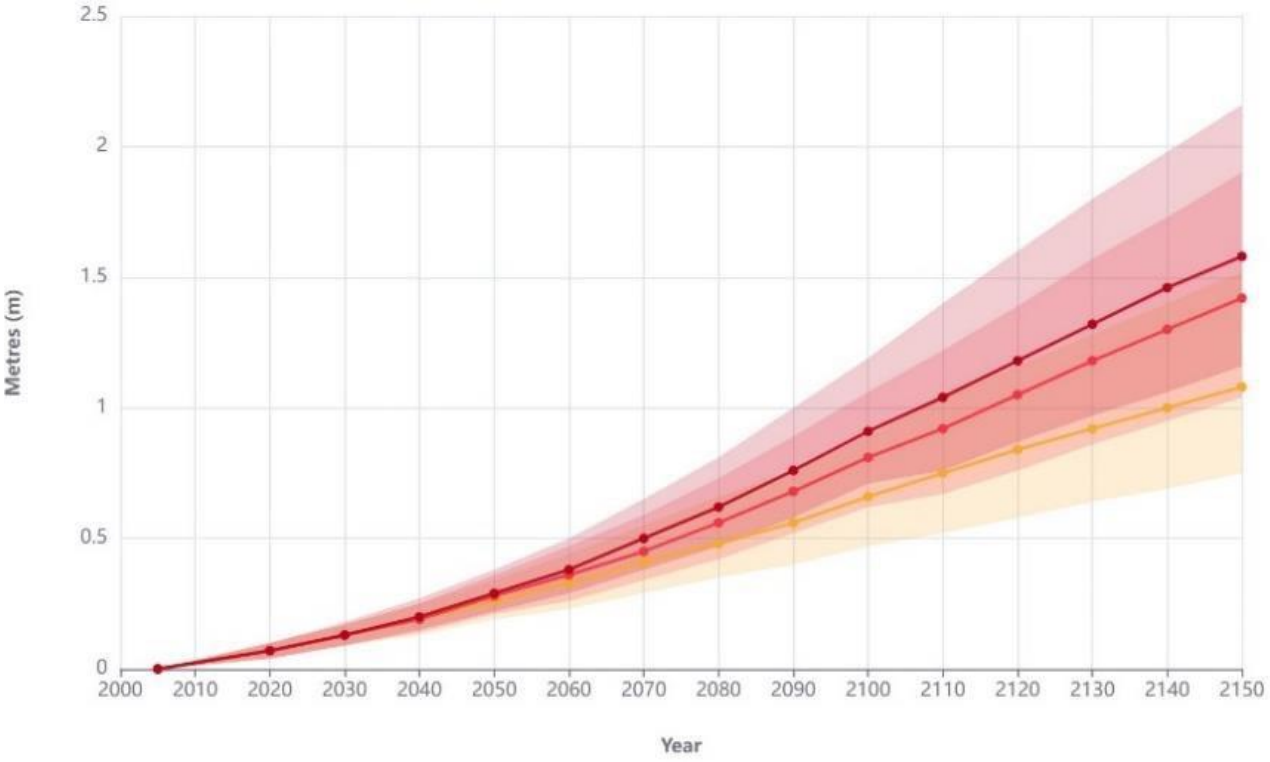

Figure 2 - Sea level rise (SLR) increments[5] with vertical land movement under potential climate change scenarios (SSP2-4.5+VLM in orange, SSP3-7.0+VLM in red and SSP5-8.5 in deep red) and likely confidence intervals (faded colour blocks) (NZSeaRise Takiwa Programme, 2022). MfE (2022) recommends that 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 Randwick School are listed in the 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 consider potential measures over time. However, there is no specific evidence (as of yet) in these plans if they may include works to the area of inner harbour coastline and Hutt River stop bank adjacent to Randwick School.

It is recommended that Randwick 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.

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Risk of Coastal Inundation (Past/Current/Future)

See Appendix B for further information.

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

Other Hazards

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

Te Awa Kairangi / Hutt River stop bank is located along the western boundary of the school between the school and the Hutt River. The Seaview port area and multiple blocks of the Moera residential area, including the main road (Waione Street) to Eastbourne and arterial route to Wainuiomata is located between the school and the Wellington inner harbour.

Other types of flooding

Randwick School has experienced flooding from pluvial and stormwater sources. Based on on-site conversations with the school principal and administration this has occurred at the bike racks located along the western side of Block G (Gym), and along the northern side of the junior block by Te Ra. During this flooding, water entered the school buildings (Block G and the Junior Block). Surface flooding of the school field occurs during any rainfall as drainage is poor. As a result of this flooding to the buildings, the school is required to close.

No anecdotal or recorded flooding from fluvial sources.

Erosion

No specific evidence of erosion of the coastline during on-site surveys. More detailed investigations into the erosion trends along the stop banks and inner harbour is required to make an accurate judgement on the erosion potential of the coastline, particularly associated with increasing sea levels.

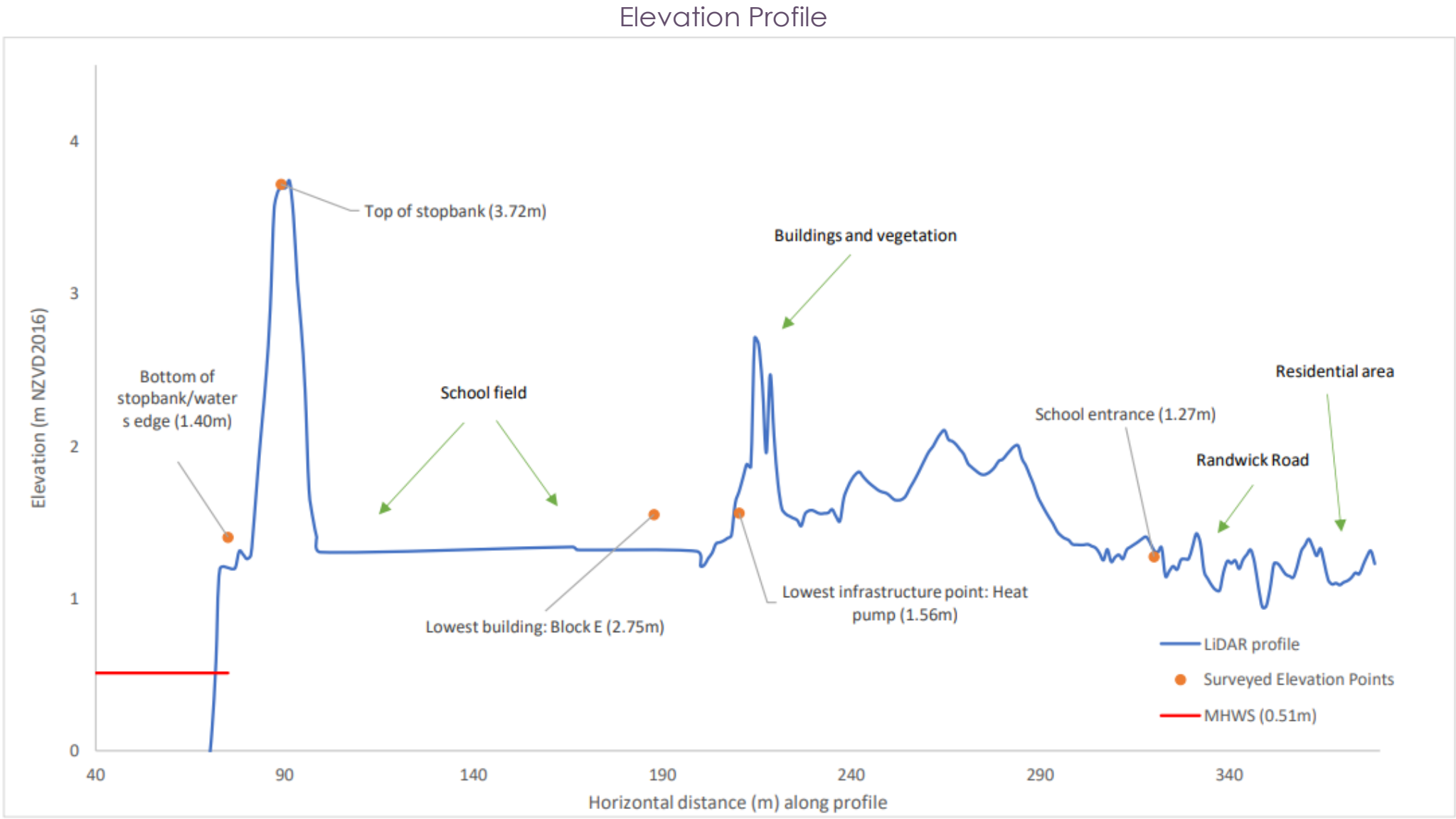

Figure 3 – Indicative profile extracted from LiDAR (1m DEM) and surveyed elevation points on site

Preferred Adaptive Pathway

The preferred adaptive pathway for Randwick 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 Randwick School should be considered in order to address the small-scale flooding issues, through relatively minor and cost-effective options. In the future, the long-term pathway for Randwick School could be to raise the finished floor levels of all the buildings to a consistent level across the school site, as this should address any internal flooding of the school buildings and allow the school to continue to be used. This long- term pathway should be aligned with any upgrades that are proposed to the stop bank.

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 Randwick 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 improvements to the school site such as establishing formal drainage on the school field to control and direct the stormwater runoff off-site.	
Trigger Points	Stormwater improvements have already been triggered and action for these improvements should be considered now to reduce existing site and building level flooding.	

Preferred Adaptive Pathway – Medium Term (2050-2070)

Pathway Approach	Accommodate	
Preferred Pathway	Consider stormwater improvements to the school site such as a pump station to help with site drainage; consider raising the finished floor levels of Block E to approximately 2.0 to 2.10 m and raising infrastructure at risk.	
Trigger Points	Constructing a pump station onsite, raising the finished floor levels of Block E and infrastructure at risk; this could be triggered when flooding occurs four times per year post improvements to stormwater infrastructure. An indicative timeframe for when this could occur is from 2050.	

Preferred Adaptive Pathway – Long Term (2070-2120)

Pathway Approach	Accommodate	
Preferred Pathway	Consider raising the finished floor levels of the remaining buildings with an aim of consistent levels around 2.0 to 2.10 m across the school site.	
Trigger Points	Raising the finished floor levels of the remaining buildings at risk could be triggered when there are planned upgrades of the stop bank.	

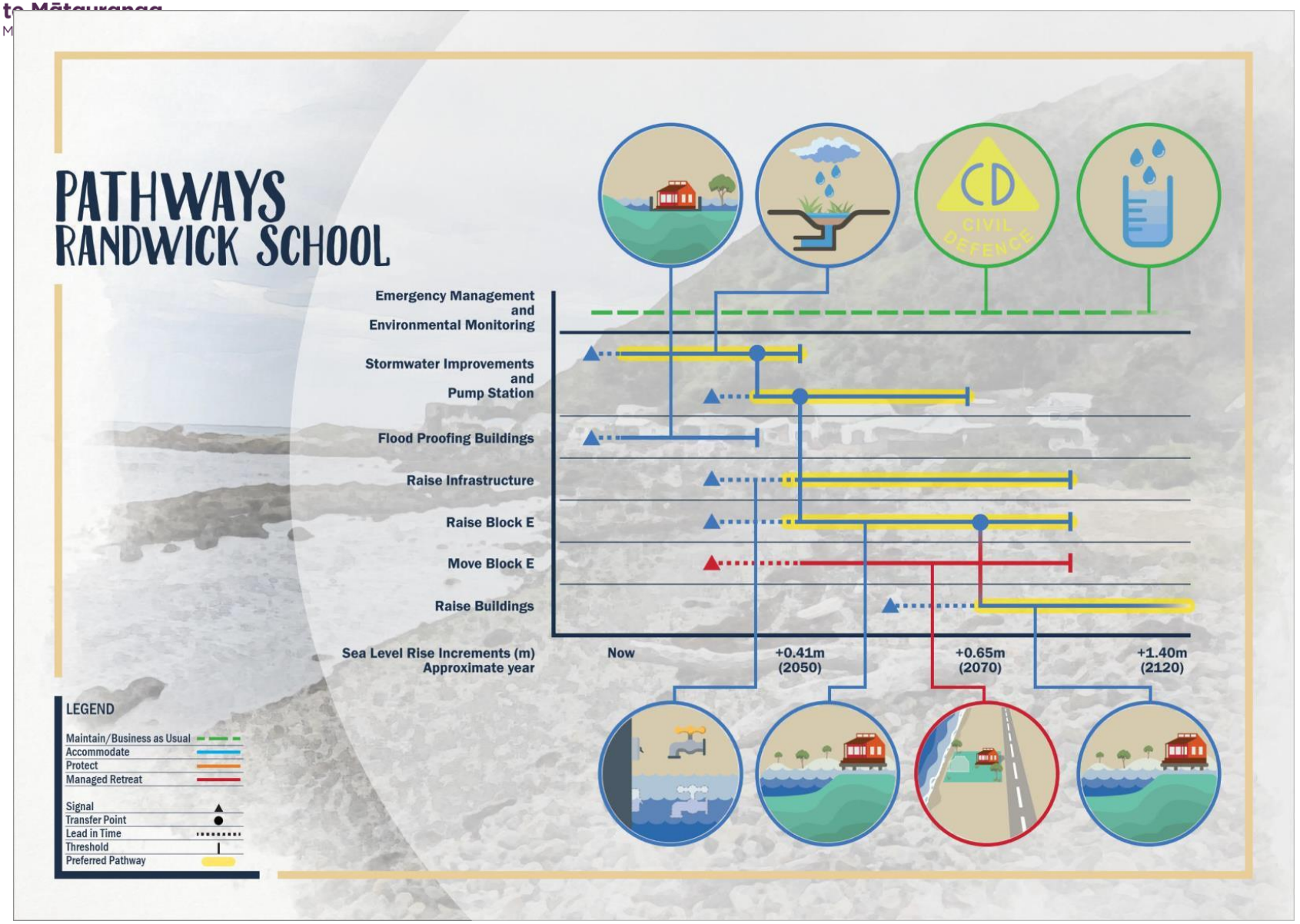

Figure 4 – Coastal Inundation Adaptation Pathway infographic for Randwick School

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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 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 flood proofing buildings with membranes or sealants.
Medium Term	D 	Consider major stormwater improvements on the school site such as constructing a pump station to aid in the drainage of flood water from the school site.
	D 	Consider raising infrastructure at risk
	E & N 	Consider moving and raising the finished floor levels of Block E.
Long Term	E 	Consider raising the finished floor levels of all buildings at risk to inundation.

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

Current Vulnerability to MHWS:

Randwick 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:

Randwick School has a medium vulnerability to coastal inundation under MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.91 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event are:

- All infrastructure surveyed
- All FFL's of buildings surveyed (except for FFL's of Block A west and Block B east.
- All access points to school site surveyed

The MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.91 m) is lower than the elevation of the crest of Te Awa Kairangi / Hutt River stop bank (3.70 m), therefore the potential for inundation due to expected overtopping is low.

Current Vulnerability to ESL100:

Randwick School has a high vulnerability to coastal inundation under the current day ESL100 scenario (2.45 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event are:

- All infrastructure surveyed
- All FFL's of buildings surveyed
- All access points to school site surveyed

The current day ESL100 (3.45 m) is lower than the elevation of the crest of Te Awa Kairangi / Hutt River stop bank (3.70 m), therefore the potential for inundation due to expected overtopping is low.

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

Randwick School has a high 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
- All FFL's of buildings surveyed
- All access points to school site surveyed

The ESL100 with the SSP3-7.0+VLM 2050 SLR scenario (2.82 m) is lower than the elevation of the crest of Te Awa Kairangi / Hutt River stop bank (3.70 m), therefore the potential for inundation due to expected overtopping is low.

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

Randwick School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (3.10 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed
- All FFL's of buildings surveyed
- All access points to school site surveyed

The ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (3.10 m) is lower than the elevation of the crest of Te Awa Kairangi / Hutt River stop bank (3.70 m), therefore the potential for inundation due to expected overtopping is low.

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

Randwick School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (3.85 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed
- All FFL's of buildings surveyed
- All access points to school site surveyed

The ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (3.85 m) is above the elevation of the crest of Te Awa Kairangi / Hutt River stop bank (3.70 m), therefore overtopping of the stop bank is likely to occur.

The overall viability of the school and the surrounding area is reliant upon the existence and maintenance of the Hutt River stop bank. Pressure on the stop bank is expected to increase due to predicted sea level rise and frequency of flood events. This assessment of school vulnerability has not accounted for the increased inundation potential from the combination of sea level rise related inundation and fluvial inundation events.

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

MfE's National Adaptation Plan:

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) released '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. In particular, that Seaview is the most vulnerable coastal unit, largely due to the significant area that is captured within the 1m sea level rise with an 100-year storm event modelled within this assessment, and that this area is largely populated, has important infrastructure, housing and businesses (date accessed 03/04/2023).

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).

As part of the Lower Hutt Community Climate Change Response, HCC will work through potential adaptation actions through a dynamic adaptive policy pathway planning. This could consider potential measures over time, such as limits on development, elevating buildings and retreating from flood-prone areas (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).

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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.