

Soft Engineering Erosion Protection Options

Soft engineering for erosion protection involves:

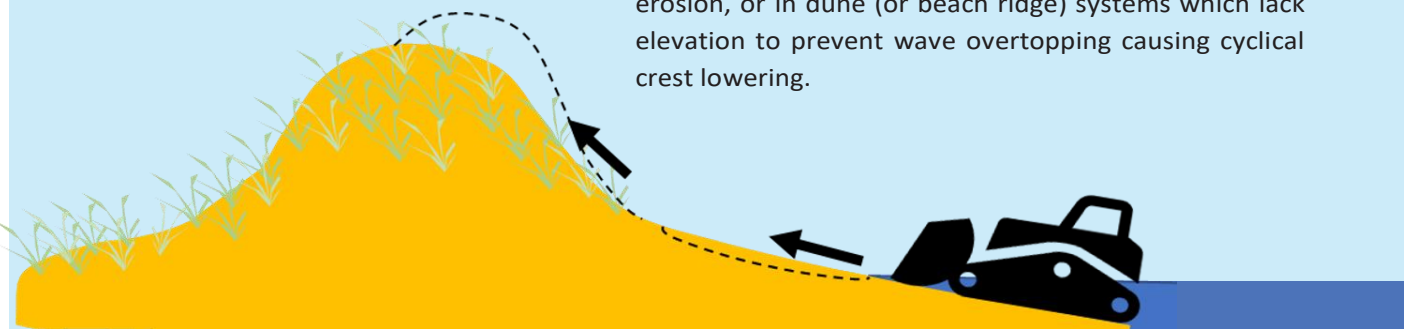
- Moving around the sand that is already on the beach to build up the beach profile to provide a greater level of protection; or
- Bringing in additional sand to help build up the beach profile volume and provide a greater level of protection.

There are various methods that you could use to achieve effective outcomes, and ways to minimise the effects that these mechanisms could have on important values of the coastal environment. These methods would require various degrees of resource consenting depending on what was proposed, and this process would require any adverse effects to be avoided or minimised to obtain the best outcome for the environment. Below are some examples of how soft engineering could be done on the Kāpiti Coast:

Ways to effectively move sediment around

Beach Scraping

Beach scraping is used as a method to transport sediment from the foreshore up to the dune to build up the crest elevation. This method is best used on beach systems with a wide foreshore that suffers periodic dune erosion, or in dune (or beach ridge) systems which lack elevation to prevent wave overtopping causing cyclical crest lowering.



Dune Recontouring

Re-contouring the dune by moving existing material around on the front and the back of the dune to a desired crest elevation and slope followed by replanting with appropriate vegetation. This is used to repair storm or human damage (e.g. blow outs) to re-establish stable dune shape for faster recolonization of the whole dune environment.

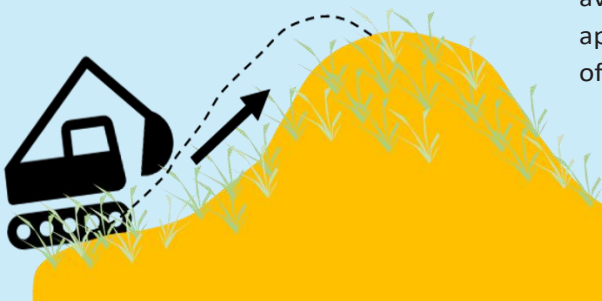


Soft Engineering Erosion Protection Options

Ways to bring sediment into the beach system

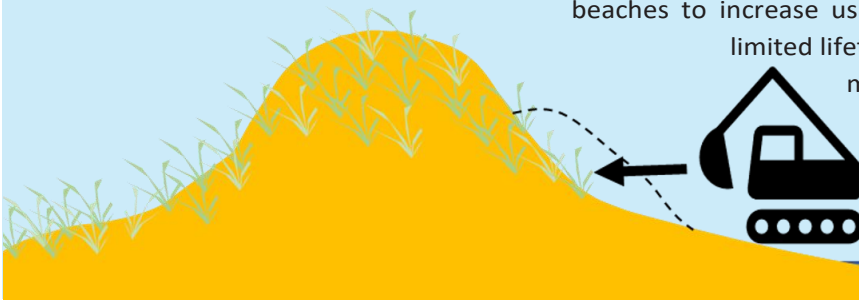
Renourishment (to the back of the beach)

Renourishment could be undertaken by bringing in additional sand and adding it to the back of the beach to build bulk and height to provide protection in storms. Providing dry sand to the back of the shore will enhance and speed up dune growth following storm events or erosion episodes. It is best applied on narrow dune systems that are in net erosional states in episodic storms, and where there is available space for the dune to retreat landward. This approach is key for when placement of material on the front of the dune or foreshore is not sustainable.



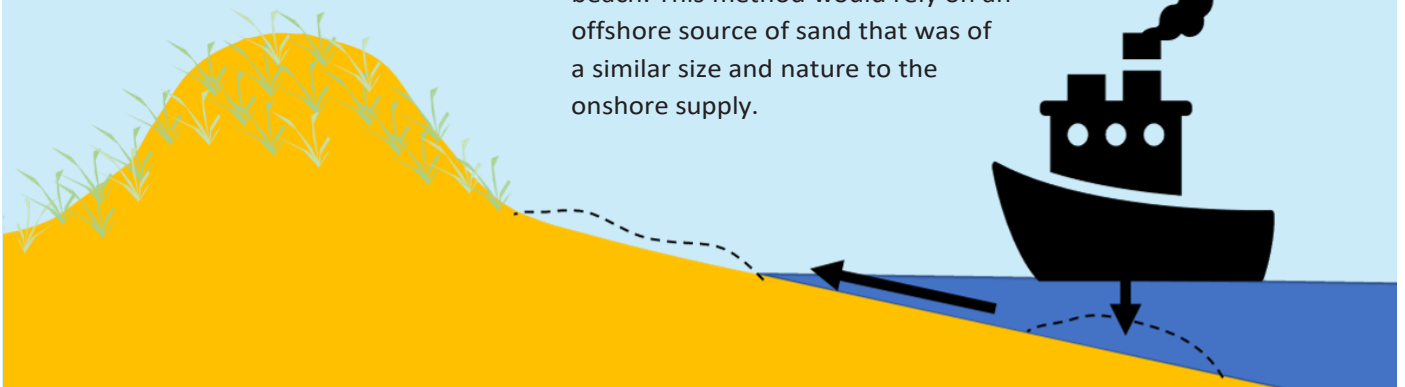
Foreshore Renourishment

Material can be placed onto the foreshore/lower beach environment rather than directly onto the dune. This is used to limit disturbance of the dune planting, with the aim that a steeper, higher upper beach will reduce run-up length and prevent it reaching the dune toe (and therefore reducing erosion potential). This method is used on recreational beaches to increase usable beach width, but can have a limited lifetime as material will quickly move alongshore and across shore if the system is out of balance with plan shape and beach slope.



Nearshore Renourishment

Material can be placed into the nearshore by a barge or directly from a dredge. This method is reliant on wave processes to transport the added sand ashore to build up the beach. This method would rely on an offshore source of sand that was of a similar size and nature to the onshore supply.



Hard Engineering Erosion Protection Options

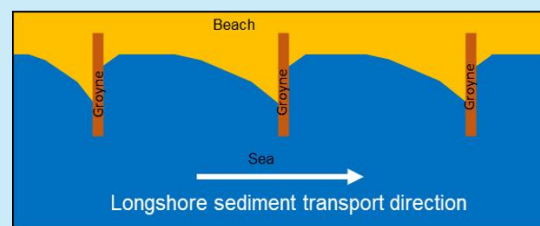
There are various types of 'hard engineering' erosion protection options that could be implemented on the Kāpiti Coast. Generally, they are designed to do one of the following:

- 'Hold the line' - use an engineered structure to keep the shoreline in its current or some desired new position. There are many variations of structure design and materials that can be used to achieve this, and to provide for different values (i.e. recreation and access, ecological values).
- 'Long-shore sediment trapping' - use an engineered structure to trap sediment being naturally transported alongshore to build up the beach therefore providing shoreline protection by the increased beach width of trapped sediment (e.g. groynes).
- 'Reduce wave attack' - place an engineered structure in the nearshore to break up wave energy which promotes the retention of sediment on the beach behind the structure (e.g. detached breakwater).

These methods would all require various degrees of resource consenting, and this process would ensure any adverse effects would be avoided or minimised to obtain the best outcome for the environment. Below are some examples of hard engineering options that could be explored on the Kāpiti Coast:

Groynes

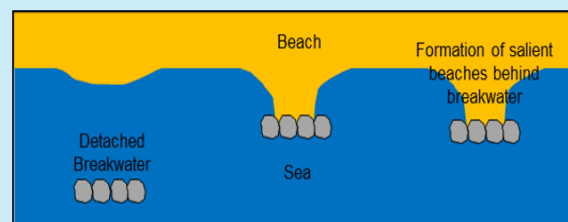
A groyne is a structure built perpendicular to the shoreline out into the sea that is used to trap sediment being transported by longshore drift. Groynes can be built out of rock, timber, concrete, or geotextile materials.



Groynes will trap sediment travelling alongshore, which can result in a build up of the beach the 'upstream' side of the structure, but erosion in the lee of the structure. Therefore, in order to be effective, typically there needs to be multiple groynes constructed to reduce the effects of erosion on the lee side.

Detached Breakwaters

Detached breakwaters are structures that are parallel to the shoreline either in the nearshore or further offshore. They aim to alter the wave conditions to reduce wave energy reaching the beach and encourage the buildup of sediment in the beach and nearshore. When these are effective, they can alter the morphology and beach form. They can also enhance ecological habitat.



There are many different designs of breakwaters, which can have their own advantages. Variations in breakwater design can include:

- Use of material (e.g. rock, geotextiles, or concrete).
- Location of the structure - in the nearshore, or offshore.
- Fully submerged, exposed at low tide, or fully exposed.
- Longshore continuity of the structure (e.g. one continuous structure vs lots of small structures).

Nearshore, exposed

Offshore, submerged

Hard Engineering Erosion Protection Options

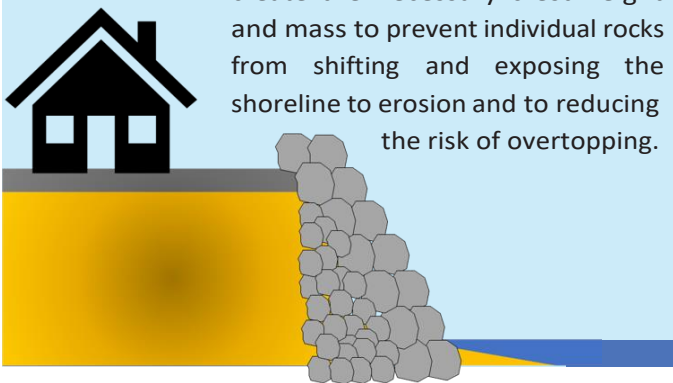
Seawalls

Seawalls are the most common structures used to 'hold the line', being a solid barrier along the shoreline which can prevent the passing of water and sediment between the land and the sea. The design of a seawall can vary depending on the environment it is being placed in, the desired location, and co-benefits trying to be achieved (e.g. reduction in coastal flooding, increased ecological values, access, and recreation).

Some examples of different types of seawalls that could be explored for the Kāpiti Coast include:

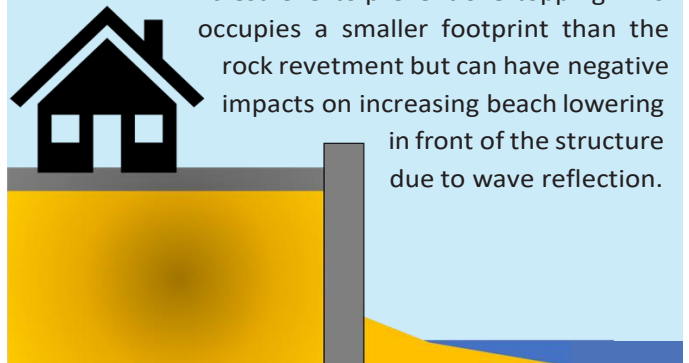
Sloping Rock Revetment

Large rocks are placed at a designed slope to create the necessary crest height and mass to prevent individual rocks from shifting and exposing the shoreline to erosion and to reducing the risk of overtopping.



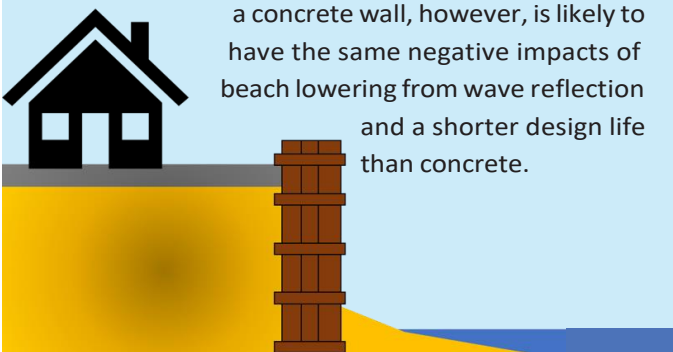
Vertical Concrete Wall

Vertical wall constructed of concrete at a designed crest level to prevent overtopping. This occupies a smaller footprint than the rock revetment but can have negative impacts on increasing beach lowering in front of the structure due to wave reflection.



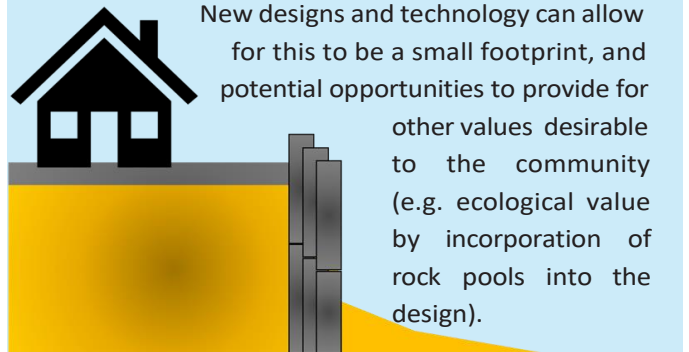
Vertical Timber Wall

Vertical wall constructed from timber. It could be considered a more natural looking alternative to a concrete wall, however, is likely to have the same negative impacts of beach lowering from wave reflection and a shorter design life than concrete.



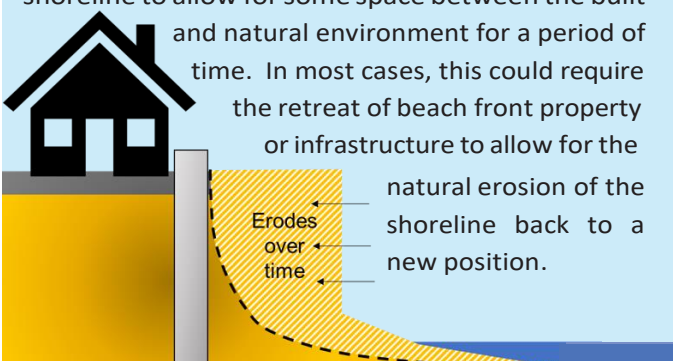
Interlocking Concrete Wall

Interlocking concrete structure: a mid-way between a vertical structure and sloping revetment. New designs and technology can allow for this to be a small footprint, and potential opportunities to provide for other values desirable to the community (e.g. ecological value by incorporation of rock pools into the design).



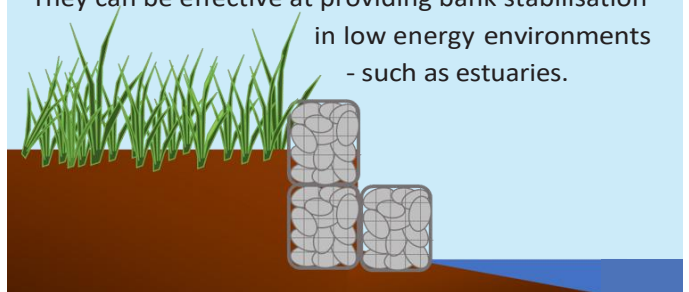
Setback Seawall

Constructing a new seawall setback from the current shoreline to allow for some space between the built and natural environment for a period of time. In most cases, this could require the retreat of beach front property or infrastructure to allow for the natural erosion of the shoreline back to a new position.



Bank Protection - Gabion Baskets

Gabion baskets are wired baskets filled with cobbles. They can be effective at providing bank stabilisation in low energy environments - such as estuaries.



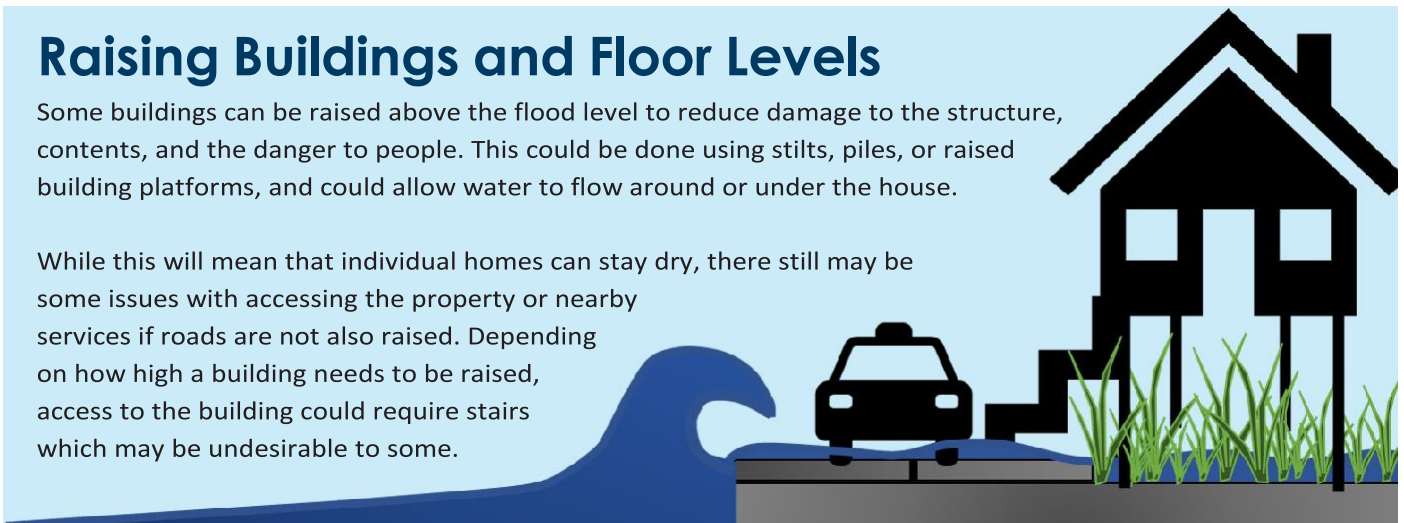
‘Accommodate’ Options

‘Accommodate’ options are about allowing people to stay in place and live with the hazard while reducing the impacts and dangers of the hazard on people and infrastructure, or making it easy to temporarily or permanently move when the hazard occurs. Accommodate options typically deal with the flood hazard, and accommodating the water when it temporarily or permanently floods the land. Accommodate options are not as effective for erosion hazards, as erosion typically results in a permanent loss of land. The following summarises the potential ‘Accommodate’ options that could be explored on the Kāpiti Coast:

Raising Buildings and Floor Levels

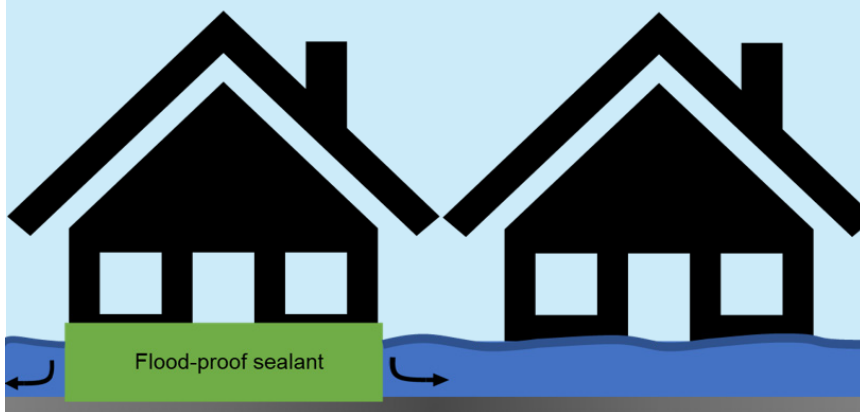
Some buildings can be raised above the flood level to reduce damage to the structure, contents, and the danger to people. This could be done using stilts, piles, or raised building platforms, and could allow water to flow around or under the house.

While this will mean that individual homes can stay dry, there still may be some issues with accessing the property or nearby services if roads are not also raised. Depending on how high a building needs to be raised, access to the building could require stairs which may be undesirable to some.



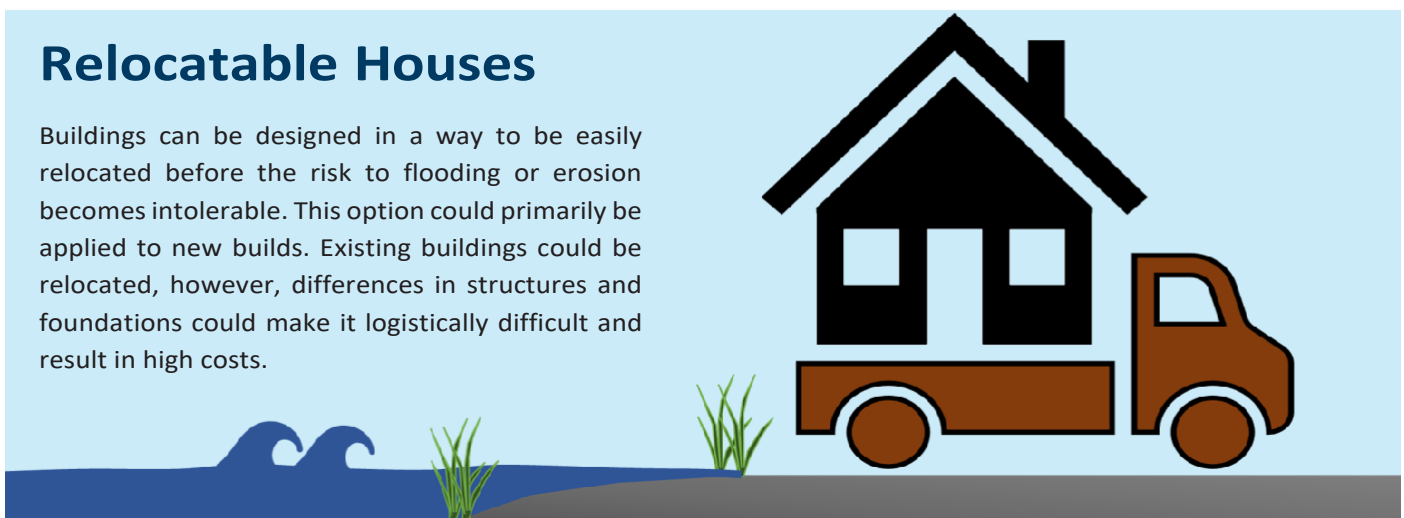
Flood-Proofing Houses

Buildings can be flood-proofed either using sealant or barriers to prevent water from entering the inside of a building. Efforts can also be made to change the use of bottom floors of buildings to reduce the consequences of them being flooded (e.g. raising electrical wiring and sockets, tiled floors). Similar to raising houses, there may still be issues with people being able to access nearby services required during event as roads may still flood and prevent access.



Relocatable Houses

Buildings can be designed in a way to be easily relocated before the risk to flooding or erosion becomes intolerable. This option could primarily be applied to new builds. Existing buildings could be relocated, however, differences in structures and foundations could make it logistically difficult and result in high costs.



Hard Engineering Inundation Protection Options

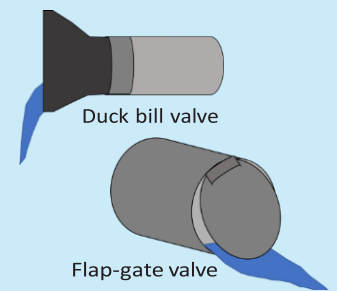
Hard engineering for coastal flood protection is generally built infrastructure that is intended to either:

- Prevent water from reaching land where it is not wanted; or
- Enable water to get back to the sea when flooding occurs.

Hard engineering options typically are undertaken to provide protection to a wider area than property level protection. Below summarises potential hard engineering flood protection options that could be explored for the Kāpiti Coast:

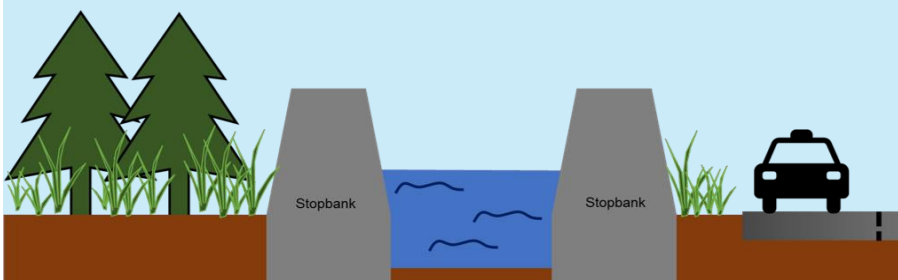
Non-return valves on stormwater

Non-return valves can be installed on the end of stormwater pipes. They allow for stormwater to drain out of the pipe, but prevent water from the sea travelling up the pipe and exacerbating the flood hazard on land. They also reduce beach sediment entering the pipes therefore reducing the risk of blockages. There are various types of non-return valves, the following being two common examples.



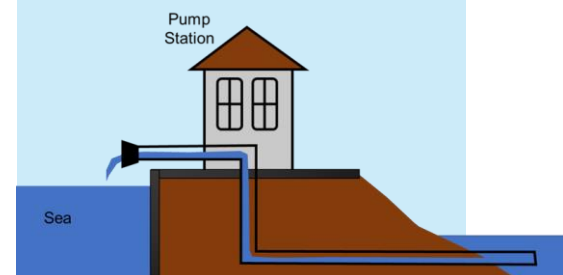
Stopbanks and Earth Bunds

Stopbanks are engineered structures, usually made from earth material, that are placed parallel to a coastline or river system to prevent flooding from the sea or river during storms. The crest height of the stopbanks would be informed through a design level for a specified flood event, which could include both coastal and river sources of flooding. These structures can also provide for other values such as recreation, as stopbanks are often also used as walking/cycling pathways.



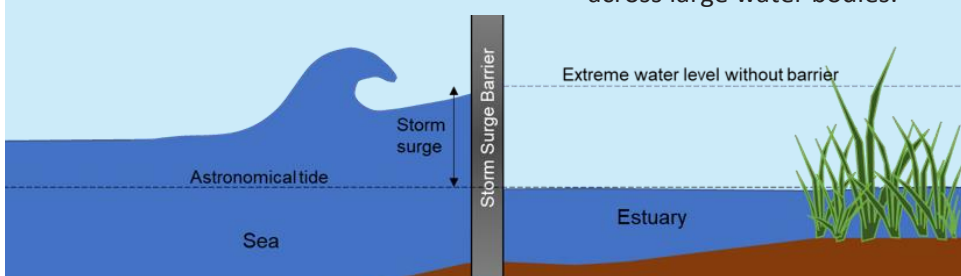
Pumpstations

Stormwater pump stations help protect areas by pumping to sea large volumes of ponded flood water from low lying areas where natural runoff is low.



Storm Surge Barriers and Flood Gates

Storm surge barriers are structures that are designed to prevent inundation due to storm surges in tidal inlets, rivers, and estuaries, while also decreasing reliance on other flood defenses inland of the barrier. Storm surge barriers are typically large structures built across large water bodies.



Flood gates act in a similar way. They are adjustable gates used to prevent storm surges entering existing waterways and can be applied to smaller waterways and inlets.

‘Enhancement’ Options

Enhancement options are approaches to improving the existing environment, infrastructure, and community understanding on coastal hazards to increase the resilience to future hazards.

Increasing Dune and Wetland Resilience

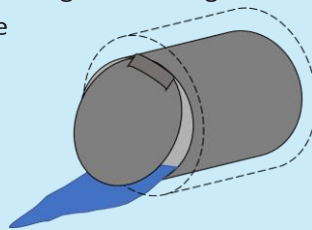
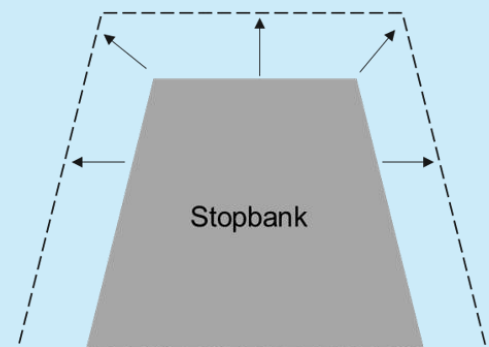


Enhancing the existing dune systems to encourage further dune growth and a greater level of resilience. This could include:

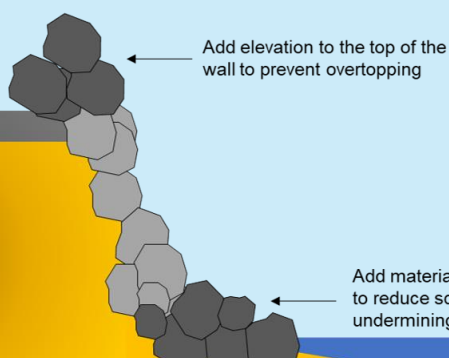
- Planting native.
- Building wind trap fences to trap sediment moving onshore.
- Pest control and trapping (flora and fauna)
- Managing access across the dune through creating walkways and vehicle access.
- Ongoing planting and weed maintenance.

Enhancement of Existing Stormwater Infrastructure

Increase the resilience of existing stormwater infrastructure to be more resilient. This could include incorporating sea level rise and higher intensity events into the design of existing stormwater management infrastructure when it is being upgraded, such as stormwater pipes and stopbanks.



Enhancement of Existing Erosion Protection



Add elevation to the top of the wall to prevent overtopping

Add material to the toe to reduce scour and undermining

Adding material to existing structures (e.g. sea walls) to increase resilience. This could include adding height to the top of the structure, as well as material to the toe to reduce toe scour and resulting failure.

‘Enhancement’ Options

Environmental Monitoring

Monitoring of the environmental responses to sea level rise (SLR) will be critical to understand changes in signals, triggers, and thresholds. Monitoring of the physical changes we see on our coast may be a combination of regular data capture - e.g. using drones, surveying, state of environment monitoring; as well as citizen science monitoring – eg relying on community members to keep records of changes they see and impacts of large events. Monitoring and data collection will play an important role in updating future models to have more certainty around future projections of shoreline and flood responses to SLR.



Community Education and Emergency Management

- Increasing community understanding and awareness of present and future coastal hazards
- Update emergency management to take account for the new information we have about how hazards may change in the future with SLR and climate change.
- Educate the community on how we can better prepare for significant events and changing hazards on our coast.



Retreat Options

Managed retreat involves proactively moving people, assets, and activities away from the hazard. This can occur progressively as the risk to individual properties becomes intolerable or could involve moving part of a community together. The land that has been retreated from is then restored to its natural state or used to (re)establish coastal protection works.

How managed retreat could be undertaken in Kāpiti is yet to be explored given it is not anticipated to be required in the short-term. Prior to managed retreat being required, or desirable, in Kāpiti it is anticipated that there will be some central government guidance on implementing managed retreat and more examples of proactive managed retreat in New Zealand that Kāpiti can learn from.

Some potential options for retreat that have been explored elsewhere in New Zealand:

- **Buyouts** - Full or partial compensation is provided to property owners to relocate to another space.
- **Leasebacks** - Government (local or central) purchases land and leases it back to existing owners.
- **Land swaps** - Alternative land is made available and property owners are offered the ability to swap their existing hazard-prone land for a new section.