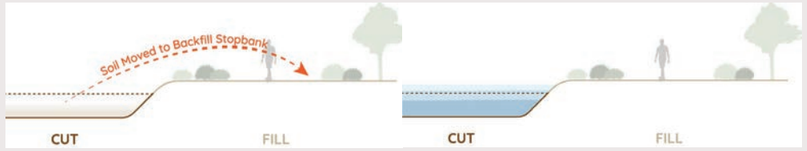
CUT AND FILL

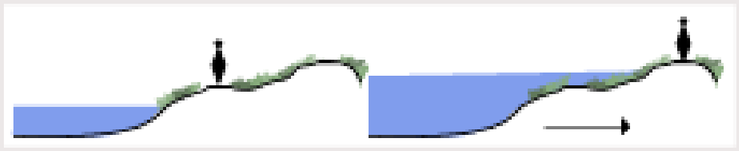


With cut/fill, soil is removed from the area in front of the stopbank and used to build up and widen the stopbanks themselves. Because this strategy 'creates land' by widening the stopbanks, they can become habitable space that can hold trails, infrastructure, and planted areas.

TERRACED LEVEES

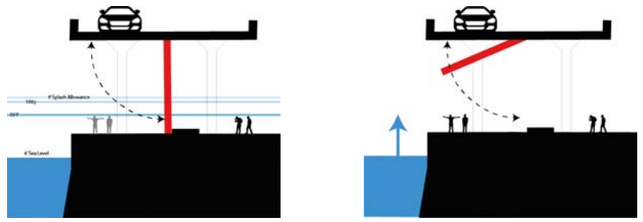
Multiple terraced wetlands allow for water treatment and retention as stormwater flows down the terraces to a body of water. People are able to use paths to move through the ecologically beneficial terraces that act as pathways.

TRANSITIONAL USE



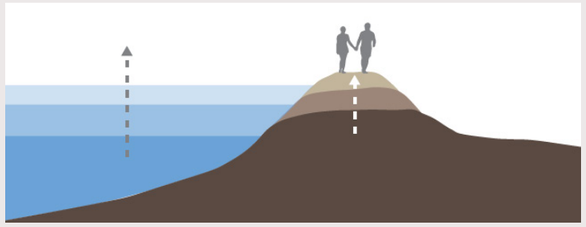
Permanent stop banks are built further back and lower to provide the same protection as higher stop banks close to the river. This creates a more natural river edge, improving habitat for native species. As sea level rises, or storms inundate lower parts of stop banks, human use is pushed to the top.

FLIP DOWN DEPLOYABLE WALL



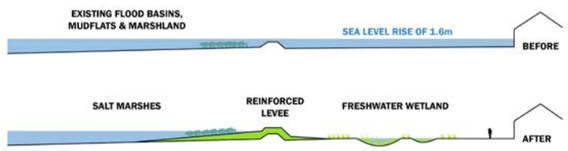
A deployable wall can flip down during storm events to protect from flooding and can transition to a permanent wall to adapt to sea level rise.

HIGHER BERMS



Over time the stopbank will be mounded higher to accommodate rising waters without compromising recreational activities prematurely.

DUAL WETLANDS



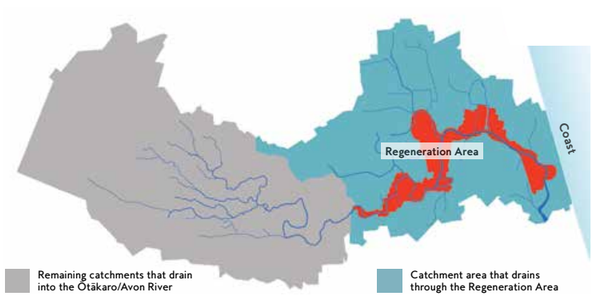
Salt marshes are restored to take in rising saltwater, while freshwater wetlands remediate and absorb excessive stormwater. Together, dual wetlands serve as sponges to absorb water.

FLOATING HOUSES

These houses are attached to docks by a mooring system that can move with the tides and sea level rise. The docks connect to artificial islands that contain the utility lines supplying the neighborhood.

FLUCTUATING WATERS IN AN URBAN ENVIRONMENT

New Zealand's National Policy Statement for Freshwater Management recognizes Te Mana o Te Wai (the integrated and holistic wellbeing of the water). The design and planning of the landings along the Ōtākaro Avon River Corridor is an opportunity to establish integrated, resilient water systems that will support the Hauora (health) of the environment, people, and river.



As the city regenerates and urban development increases, permeable surfaces become less available. Water runs off roads and sidewalks, it picks up pollutants such as petroleum, which make their way to the river. Approximately 1/3 of the area's catchment drains through the designated Regeneration Area, where the project sites are located. This sets up the project sites as opportunities for green stormwater infrastructure applications.

ŌTĀKARO/AVON AS A COASTAL RIVER

The Ōtākaro Avon River is a coastal river with water levels influenced by tidal cycles, this means project sites will need to be planned for water levels fluctuating on a daily basis. Sites closer to the mouth of the river will experience stronger tidal influence than sites further upriver. As a coastal river, the Ōtākaro Avon also contains brackish waters, which affects the ecology of the river and its edges. Salt intrusion is stronger at the mouth of the river than further upstream.

INUNDATION CONSIDERATIONS

Sea Level Rise (SLR)

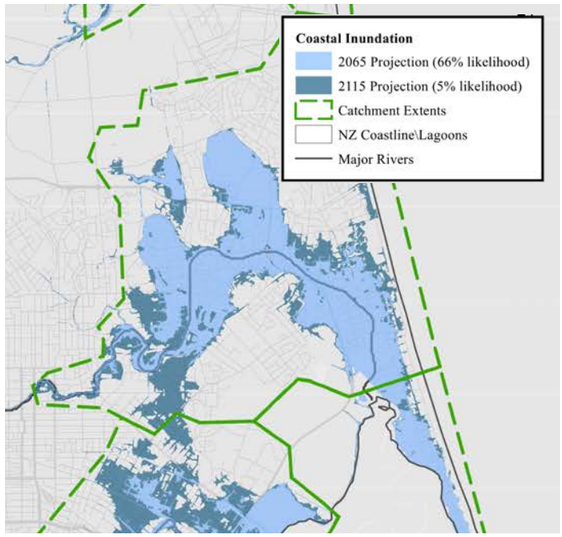
New Zealand's Ministry for the Environment expects between **0.65 and 1.9 metres** of sea level rise over the next 100 years.

Ground Water Rise

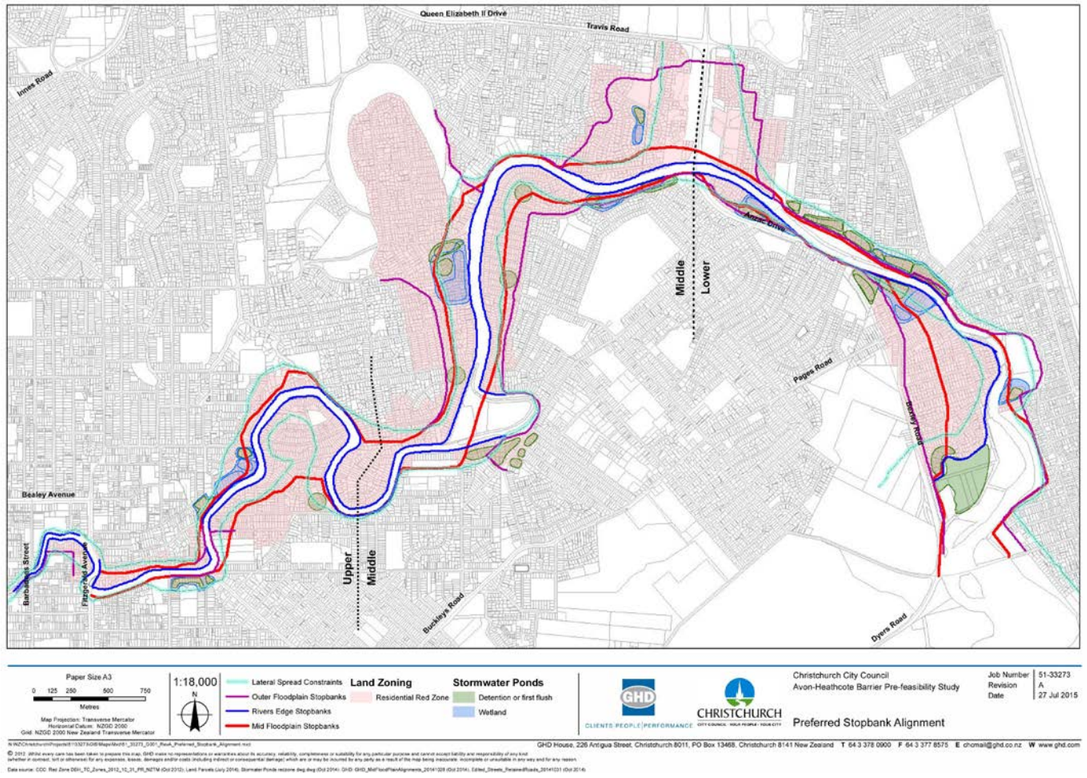
Rising sea levels will gradually raise the ground water table. This will expose groudwater to the surface in low elevation areas creating wetlands and reducing the soil's capacity of holding water.

Seasonal Flooding

As water levels rise and storm events become more extreme, flooding events will become more frequent and severe, endangering people and infrastructure.



Excerpt of the Coastal Inundation Map as part of the Land Drainage Recovery Programme from the Tonkin and Taylor Ltd. Coastal Hazards Assessment Stage 2 Report. Presented to Christchurch City Council in July 2017.



A preferred stopbank alignment from the 2015 Avon-Heathcote Barrier Pre-feasibility Study. Provided by Christchurch City Council.

A NEW STOPBANK STRATEGY

Much of Christchurch is low-lying along the river floodplain. Existing stopbanks provide protection from flood risk, but some are in need of repair and others will need to be replaced in the future. The Regenerate Christchurch Plan suggests pushing the stopbanks further back or widening the stopbanks to create space for riverside activity. This strategy would also enable a more naturalized river edge that could act as a buffer during flood events, as well as improve the river's native ecology. Stopbanks also act as part of a dual wetland system, which slows and filters urban stormwater. Without separating the stormwater detention cells and the riparian wetlands, tidal inundation, SLR, and flooding events could flood into the stormwater detention cells, and allow contaminants to escape into the the river.

Areas designated as wetlands allow for inundation during storm surge and flooding events, these areas are meant to hold water coming from the river and direct flows to the river, which are less polluted than urban stormwater.

Widened stopbanks creates space for recreation and river connection

Primary stormwater cells located on the other side of the stopbanks, away from the river, stop contaminated water from reaching the river, and treats it