Avon-Heathcote Estuary Ihutai Trust

Estuary Management Plan

2020-2030

Estuary of the Heathcote and Avon Rivers/Ihutai, Ōtautahi/Christchurch, Aotearoa New Zealand.
Photo by Paul Corliss

Estuary

Management Plan

The Avon-Heathcote Estuary and lower reaches of the Ōtākaro (Avon) and Ōpāwaho

(Heathcote) Rivers

2020-2030

Prepared by the Avon-Heathcote Estuary Ihutai Trust (Estuary Trust)

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The vision of the Avon-Heathcote Estuary Ihutai Trust is to

Restore the mauri; the cultural and ecological health of Te Ihutai

Toitū te taonga ā iwi

Toitū te taonga ā Tāne

Toitū te taonga ā Tangaroa

Toitū te iwi

Communities working together for:

Clean water

Healthy ecosystems

Open space

And safe recreation

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1 CONTEXT

1.1 Introduction

Te Ihutai/Avon Heathcote Estuary, with its tributaries the Ōtākaro/Avon and Ōpāwaho/Heathcote Rivers, is a taonga (treasure) for Te Rūnanga o Ngāi Tahu, the principal iwi in Te Wai Pounamu/the South Island of Aotearoa New Zealand, and the people of Ōtautahi (Christchurch). Te Ihutai and its catchment are of significant cultural and spiritual importance, having been a place of settlement and mahinga kai for Waitaha, Ngāti Māmoe and Ngāi Tahu since about 1290AD. Today the estuary and its catchment continue to be held in high regard for their ecological values, landscape, and recreational values.

The purpose of this Estuary Management Plan (the Plan) is to work toward restoring the mauri (life force) of Te Ihutai, to restore the estuary to full ecological and cultural health so that once again it can provide mahinga kai: the natural resources that sustain life, including people. Mahinga kai is about both the place and the ability to gather resources there. It is essential to sustain mana and kaitiakitanga, or what today we call guardianship. Such practices remain a foundation of Ngāi Tahu values but have become increasingly difficult as species and habitats are compromised, degraded, or lost.

Protecting and enhancing key features, and investigating and eliminating sources of contaminants, are important challenges for managing and improving the estuary. Ongoing monitoring and cultural assessments are vital to understand the success of actions. A strategic and coordinated management approach across all levels of government, Ngāi Tahu, industry and the community remains our best prospect for a future clean and healthy estuary. The Plan sets the context, identifies goals and prioritises actions to achieve these goals.

The Plan is a community document, the success of which depends on the goodwill, participation, and commitment of those identified as responsible for carrying out the actions. It addresses the current issues and concerns of the Avon-Heathcote Estuary Ihutai Trust (Estuary Trust). The Plan is also a living document and will be updated as necessary. The Estuary Trust's website www.estuary.org.nz holds the current Plan.

A series of events triggered a review of the ecological and cultural decline of Te Ihutai. The upgrade of Christchurch City's sewerage system came with the promise of improved water quality. Officially the upgrade opened in March 2010 when the wastewater from the Bromley Sewage Treatment Plant began discharging three kilometres out into Pegasus Bay via an ocean outfall. Then, the Canterbury Earthquake Sequence (CES) 2010-2012 caused significant uplift of areas of the estuary, disrupting the ecological system of the mudflats and damaging sewerage and roading infrastructure. More recently the 2019-2020 drought and the Covid-19 pandemic of 2020 have prompted a rethink of the values placed on nature. Now with wastewater and stormwater infrastructure largely repaired and the potential for innovative land uses adjacent to Te Ihutai, new opportunities have emerged to improve the estuary's ecological and cultural health.

The Estuary Trust shares this aspiration with its partners Te Ngāi Tūāhuriri Rūnanga and Te Ihutai Ahu Whenua Trust (Ihutai Trust), who hold mana whenua (authority over the area, or customary land and water rights) over Te Ihutai (Te Runanga o Ngai Tahu Act 1996 [2001]). Te Hapū o Ngāti Wheke of Te Rāpaki o Te Rakiwhakaputa also have an historical connection with Te Ihutai. Together with mana whenua

the Estuary Trust's partners Environment Canterbury and the Christchurch City Council support this Plan.

The Estuary Trust considers that restoring Te Ihutai to health to the extent that it is safe to gather mahinga kai will have wide-ranging benefits. The Trust hopes that this Plan will guide future developments in Ōtautahi and looks forward to working with mana whenua, Environment Canterbury and Christchurch City Council to restore the mauri, the ecological and cultural health of Te Ihutai.

1.2 A shift in priorities

The Plan's Schedule for Action (Section 6) reflects a global shift towards ecological planning and management that is less anthropocentric, a shift necessitated by long-term ecological challenges such as the climate and ecological crisis. The Plan strengthens earlier advice to the Estuary Trust, in 2017, that ecological values should be prioritised "when planning recreational activities and public access to the Estuary" (Wildlands Report 2017). New research on bird disturbance in 2019 and 2020 has continued to buttress the evidence base for the advice to prioritise ecological values (Kaldor 2019, Figueiredo 2020).

Only by reordering its priorities to favour nature will the Estuary Trust achieve the goal of restoring the mauri of Te Ihutai.

Guided by this purpose, the Plan proposes a greater commitment to waterway management, ecological restoration, research and monitoring to improve the cultural and ecological health of Te Ihutai.

1.3 Area covered by the Plan

The area covered by the Plan includes Christchurch City Council reserves surrounding the estuary and the Te Huingi Manu Wildlife Refuge that encompasses the Bromley oxidation ponds and the adjacent estuary edge. The area includes all parts of the estuary permanently covered in water; habitats that range from mudflats, sand, seagrass and shellfish beds to restored and constructed saltmarshes, to freshwater treatment ponds, grasslands and paddocks, scrub, and regenerating forest.

The Estuary Trust's previous plan (the 2013 Ihutai Management Plan) covered the Coastal Marine Area and lands immediately surrounding the margins of the estuary. This included the area of the estuary mouth to approximately 300 metres upstream of the Ōtākaro/Avon and Ōpāwaho/Heathcote rivers, and the wastewater treatment ponds. The area covered by this 2020 Plan extends upstream beyond those previous limits to secure improvements in upstream water quality for ecological restoration in these catchments. (See Figure 1 and Figure 2.) Figure 1 is based on the area identified as the Avon-Heathcote Estuary coastal wetland system for purposes of habitat and wildlife management.

Figure 1: Map of the estuary showing area covered by the Plan. Courtesy of CCC

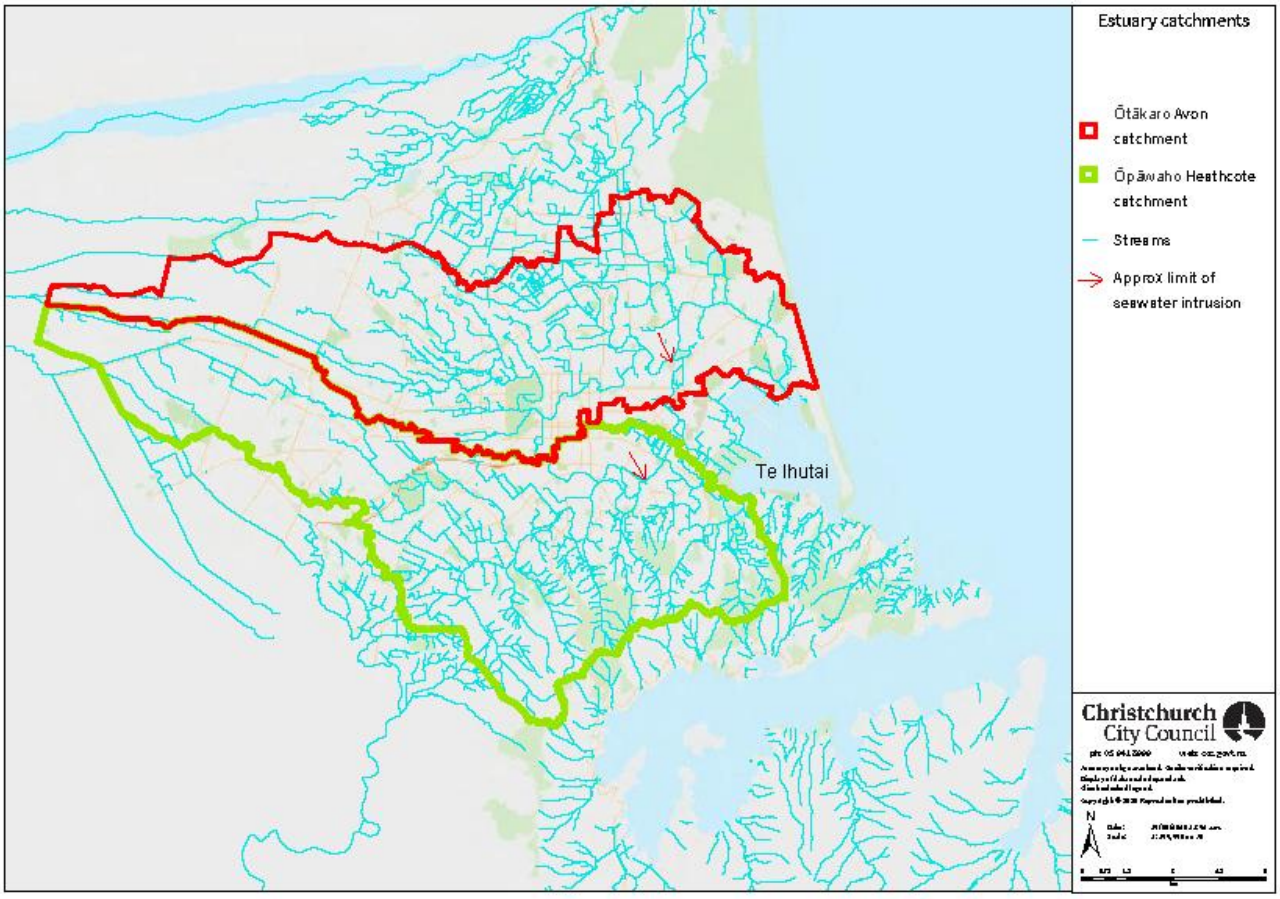

Figure 2: Te Ihutai/Avon-Heathcote Estuary catchment. Sourced from CCC

2 HISTORY

2.1 Place

Te Ihutai is an 880 hectare, geologically young coastal feature, located approximately 12 kilometres east of Christchurch's city centre. Around 1500 years ago a ready supply of offshore sand from the continental shelf and the longshore drift of sediments from the Waimakariri and Ashley Rivers built up to the landward edge of the current estuary (McFadgen & Goff 2005). The spit developed from sediment that moved southward from the Waimakariri River, closing off what was a small embayment and now forming what we call Te Ihutai, the Avon-Heathcote Estuary. It is now a water body sheltered from open ocean swells, receiving freshwater from the Ōtākaro/Avon River and Ōpāwaho/Heathcote River that mixes with seawater from the incoming tides.

The estuary and Southshore Spit continue to be dynamic systems. Aerial photography shows that the south end of the spit has been mobile over the last century. Up to 20 houses along the open-coast and estuary shores of the spit tip now occupy areas that were foreshore in the 1940s.

2.2 People

The history of Te Ihutai, beginning with the country's late settlement by humans, offers insights that may assist the estuary's ecological and cultural recovery. Waitaha were the first people and tīpuna (ancestors)

to settle in two main kāinga around Te Ihutai; first in a substantial village at Te Raekura/Redcliffs around 1290AD and later at Te Ka-a-Te Karoro/South New Brighton. Then in the 1500s, Ngāti Māmoe settled on Tauhinukorokio/Mt Pleasant and in the 1600s, Te Rūnanga o Ngāi Tahu established a pā from which they moved from site to site. Te Ihutai was renowned for its abundant fish and shellfish, including tuna (eels), inanga/inaka (whitebait), pātiki (flounder), tuangi/tuaki (cockles) and pipi. (See Ngāi Tahu Atlas, www.kahurumanu.co.nz/atlas.) The catchment – outlined in Figure 2 – contained springs, waterways, wetlands, and swamps. Equally important to mana whenua was – and still is – the connection of the estuary to the land and the mountains according to the principle Ki uta ki tai, from the mountains to the sea.

With European settlement of Canterbury from 1850, Te Ihutai became a transport route for small ships via the Ōpāwaho/Heathcote and Ōtākaro/Avon to central Christchurch. But river travel and trade rapidly ceased because settler activities, especially vegetation clearance across the catchment, caused the river channels to silt up. The Lyttelton rail tunnel's completion in the 1860s also made the seaport accessible in Lyttelton. By the 1890s polluting industries such as tanneries along the banks of the Ōpāwaho/Heathcote contaminated both the river and estuary.

From the late 1860s the growing city established a 900-acre nightsoil reserve in the sandhills in Bromley followed by a neighbouring irrigation reserve, where in the 1880s the Christchurch Drainage Board set up a sewage farm beside Te Ihutai with settling ponds for the city's effluent (Sketch map Christchurch Drainage District 1882, Owen ed. 1992, Mein Smith 2020).

In parallel, in 1868 the Native Land Court set aside a 10-acre coastal reserve on the estuary's northwest edge on behalf of Kaiapoi Rūnanga landowners. This was in partial recompense for earlier unjust dealings that were contrary to law and the Treaty of Waitangi (Evison 1997). A fishing easement, Te Ihutai Māori Reserve (MR 900) recognised and preserved fishing rights by providing access to the estuary fishery. The creation of the reserve reflected the colonial government's failure to keep the promises sought by Ngāi Tahu to exclude the land from sale and to maintain access to mahinga kai needed to give them a stake in the developing economy. By 1900 few iwi members remained in Ōtautahi due to the poor environmental conditions. Most moved north of the Waimakariri River to Tuahiwi, while others resided on reserves at Wairewa (Little River), Ōnuku (Akaroa), Rāpaki, and Koukourārata (Port Levy). Even so, Te Ihutai remained a site of cultural significance (Lobb 2009).

As Christchurch grew, unmanaged development continued along both urban rivers and combined with the dumping of waste beside the estuary led to environmental decline, eroding the ecological and cultural health of the estuary and its catchment. In 1956, a century after Christchurch was founded, the Drainage Board confiscated MR 900 under the Public Works Act to build the Bromley oxidation ponds for a new sewerage scheme that discharged treated wastewater directly into the estuary. Although the sewerage upgrade brought health benefits to residents, the continued use of the estuary for the city's waste perpetuated the history of disregard for mana whenua and for the estuary.

Te Ihutai Ahu Whenua Trust (Ihutai Trust), established under a 1993 Act, represents the descendants of the original owners of Te Ihutai Māori Reserve (MR 900). (See https://maorilandcourt.govt.nz.) The Estuary Trust acknowledges the hurt that the 1956 confiscation inflicted on the original grantees and their descendants – today's beneficial owners to whom the Ihutai Trust reports – when mana whenua

past and present had already suffered dispossession from colonisation. The Estuary Trust also acknowledges the offence caused by the historical mistreatment of Te Ihutai and its catchment.

The Estuary Trust was constituted in 2002 out of public concern about the state of the estuary, and the city's wastewater treatment gradually improved. By 2008 it was no longer publicly acceptable to discharge treated wastewater into Te Ihutai. In 2010, the Christchurch City Council completed the ocean outfall to pump treated sewage three kilometres offshore. But the promised improvements in water quality were disrupted by the CES 2010-2012. Damaged stormwater and wastewater infrastructure meant that pollution again entered estuary habitats.

By 2020, water quality had improved markedly with the ocean pipeline transporting treated wastewater to the ocean and repairs to stormwater infrastructure largely completed. Further, the Global Settlement Agreement signed by the Crown and Christchurch City Council in September 2019 opened the way for ecological restoration projects within the residential red zone. This provided a unique opportunity for the Estuary Trust to act: a-once-in-a-generation chance to restore the estuary's ecological and cultural health.

2.3 Cultural health

Many issues relating to the loss of mahinga kai in Canterbury remain unresolved. The State of the Takiwā survey of 30 sites (Pauling et al. 2007) concluded that most sites in the estuary and its catchment were in poor to very poor ecological health. Repeat surveys by Lang et al. (2012) following the CES 2010-2012 produced similar results. Of five estuary sites, two at Te Raekura/Redcliffs and Rapanui/Shag Rock had improved in health by 2012, one showed no change and two had declined. Three estuary sites scored as poor and one (the estuary outfall) very poor in health, with only Rapanui/Shag Rock rated moderate. All sites were assessed as unsuitable for gathering mahinga kai. Except for the sites at Te Raekura/Redcliffs (NIWA 2020), this remains the case today.

Where improvements were recorded between 2007 and 2012, these were due to riparian restoration efforts in the catchment (Lang et al. 2012). The management responses required to protect and enhance Ngāi Tahu values include improvements to water quality, especially through improving stormwater quality and sediment control; improvements to habitat values through the restoration and conservation of indigenous saltmarsh and saltmeadow, as well as mudflats; non-disturbance of wetland habitats and migratory birds; and restoration to health of fish and shellfish stocks.

3 COMMUNITIES WORKING TOGETHER

Communities working together is the fundamental philosophy of the Estuary Trust and will help to ensure the integrated management of the issues that affect Te Ihutai. The Estuary Trust is also committed to working closely with relevant parties to ensure effective integrated management and to address four main community concerns that were identified in the 2013 Ihutai Management Plan: [1]

- clean water
- healthy ecosystems
- open space, and
- safe recreation

[1] In 2020 the Estuary Trust renamed its management plan the Estuary Management Plan to avoid confusion with the Ihutai Trust, ie Te Ihutai Ahu Whenua Trust.

The Estuary Trust respects the relationships of Ngāi Tūāhuriri and the Ihutai Trust with Te Ihutai and hopes that its partnership with mana whenua will encourage participation and support for restoration projects and other undertakings.

Community engagement with the local community and residents across Christchurch is important to improve the public perception of Te Ihutai, to help it be recognised as a significant ecological and cultural feature, and to develop the sense of connection that will prompt people to participate in restoration projects or simply to enjoy its natural values. Local catchment groups such as the Avon-Ōtākaro Network also play an important role in the management of the wider catchment area.

The management of the estuary is the responsibility of both the Christchurch City Council and Environment Canterbury under the Resource Management Act. City responsibilities are largely focused on the land margins outside the Coastal Marine Area while Environment Canterbury is responsible for the control of activities on the estuary, discharges, extraction of sand, shingle and other natural materials, and hazard mitigation. Both councils work together through the Christchurch West Melton water zone committee to improve water quality. In 2004, both councils became signatories to a ten-year Memorandum of Understanding to support the Estuary Trust to achieve its goals under the 2004 and 2013 Ihutai Management Plans. The MOU was revised and re-signed by the three parties in 2016.

Education and research organisations, from schools through to the universities and other research organisations, are central in helping the Estuary Trust make informed management decisions. Scientific and social studies of the estuary will continue to provide valuable data and information as part of estuary management.

There are several recreational groups based around the estuary whose members undertake activities on the water or nearby, including yacht clubs, wind and kite surfing groups.

The Estuary Trust will continue to develop relationships and work with local industry and businesses at Ferrymead, along the Ōpāwaho/Heathcote River and at Redcliffs to provide resources and help improve local community engagement in the area covered by the Plan.

3.1 Clean water

3.1.1 Reduced water quality

For 20 years, Environment Canterbury and Christchurch City Council have regularly measured the water quality of the rivers and estuary. Water quality is a significant factor affecting biodiversity, health and the survival of organisms. The removal of treated wastewater from the estuary in 2010 resulted in immediate improvements in water quality and reduced nutrients and fine sediments. But water quality declined rapidly soon afterwards, following the earthquake of 22 February 2011. Since 2013 there has been some improvement, although there are still regular fluctuations for some environmental parameters. The quantities of fine sediment in the water remain relatively high in the Ōpāwaho/Heathcote River near the Ferrymead Bridge (Bolton-Ritchie 2019). While trends in different measures of water quality were variable from 2014 to 2019, turbidity (water clarity) improved (NIWA 2020).

3.1.2 Flood, stormwater and groundwater management systems

Because large parts of Christchurch City were built on drained wetlands, especially in the lower reaches of the Ōtākaro/Avon and Ōpāwaho/Heathcote Rivers, floods, storms, and tidal inundation have always posed a threat. To reduce risks of flooding, large stormwater ponds with a focus on green infrastructure are being built in the upper Ōpāwaho/Heathcote catchment. These will also reduce the volume of sediment entering the waterways. Similar opportunities are available for the Ōtākaro/Avon using the

Ōtākaro residential red zone land. Regulations also now minimise inputs from riverside industries. Consequently, the quality of water entering Te Ihutai from the catchment should improve. Groundwater inputs will still pose an ongoing issue, however, and will need to be carefully monitored.

3.1.3 Nutrient levels

Te Ihutai, like many estuaries worldwide, has received excessive nutrients from high macroalgal production resulting in eutrophication. The low oxygen levels and macroalgal blooms have degraded the marine environment. The main nutrients measured in the annual Environment Canterbury Healthy Estuary and Rivers of the City monitoring programme and Christchurch City Council Rivers Water monitoring programme (monthly sampling from 2007 to present) show inputs of nitrogen (nitrates and ammonia) and phosphorus (dissolved phosphorus). Estuary nitrate and dissolved phosphorus levels are generally site specific. Total nitrogen levels trended down over the period 2014-2019 but levels of ammonia trended upwards at the Beachville Rd site (NIWA 2020). Nitrogen, for example from the rivers, therefore does not explain the recent increased algae blooms. Addressing levels of nitrates in rivers will not improve the water quality of the estuary because there are different trigger values for the estuary than for the rivers. Levels of ammonia improved markedly in recent years, remaining well below the trigger values that are expected to affect 95 per cent of species.

At Sandy Point on the northwest edge of the estuary west of the oxidation ponds, the monitoring site has demonstrated consistently poor water quality (Bolton-Ritchie 2017, 2019, 2020). Regular monitoring shows that nutrient concentrations are higher than expected at Sandy Point, but the source of seepage is unknown. The Estuary Trust would like to see water quality monitoring is carried out on drains near the oxidation ponds along with flow analyses of the Linwood Canal.

In summary, the closer to the ocean the better the water quality of the estuary (NIWA 2020).

Ongoing monitoring by regional and local authorities and investigations by professional research bodies such as NIWA[2] are essential to identify significant changes in estuary health. The report of June 2020 prepared by NIWA for Environment Canterbury on Water quality of Estuary of the Heathcote and Avon Rivers/Ihutai, for example, demonstrates the value of long-term, systematic monitoring. The Estuary Trust endorses the recommendations from the 2020 NIWA report (section 7.7):

- Retain existing water quality sampling site locations to maintain the high value of time series
- Collect and analyse data from drains near the wastewater treatment ponds, as well as continue current monitoring of rivers and coastal waters
- Regular monitoring of intertidal macroalgal populations as a key indicator of biological response to climate and nutrient conditions in the estuary
- Improve detection of trends in metals and bacteria through methods with lower detection limits
- Add visual clarity measurements to monitoring at estuary sites

To restore the mauri of Te Ihutai, Environment Canterbury and the Christchurch City Council need to maintain the focus on improving water quality.

[2] National Institute of Water and Atmosphere.

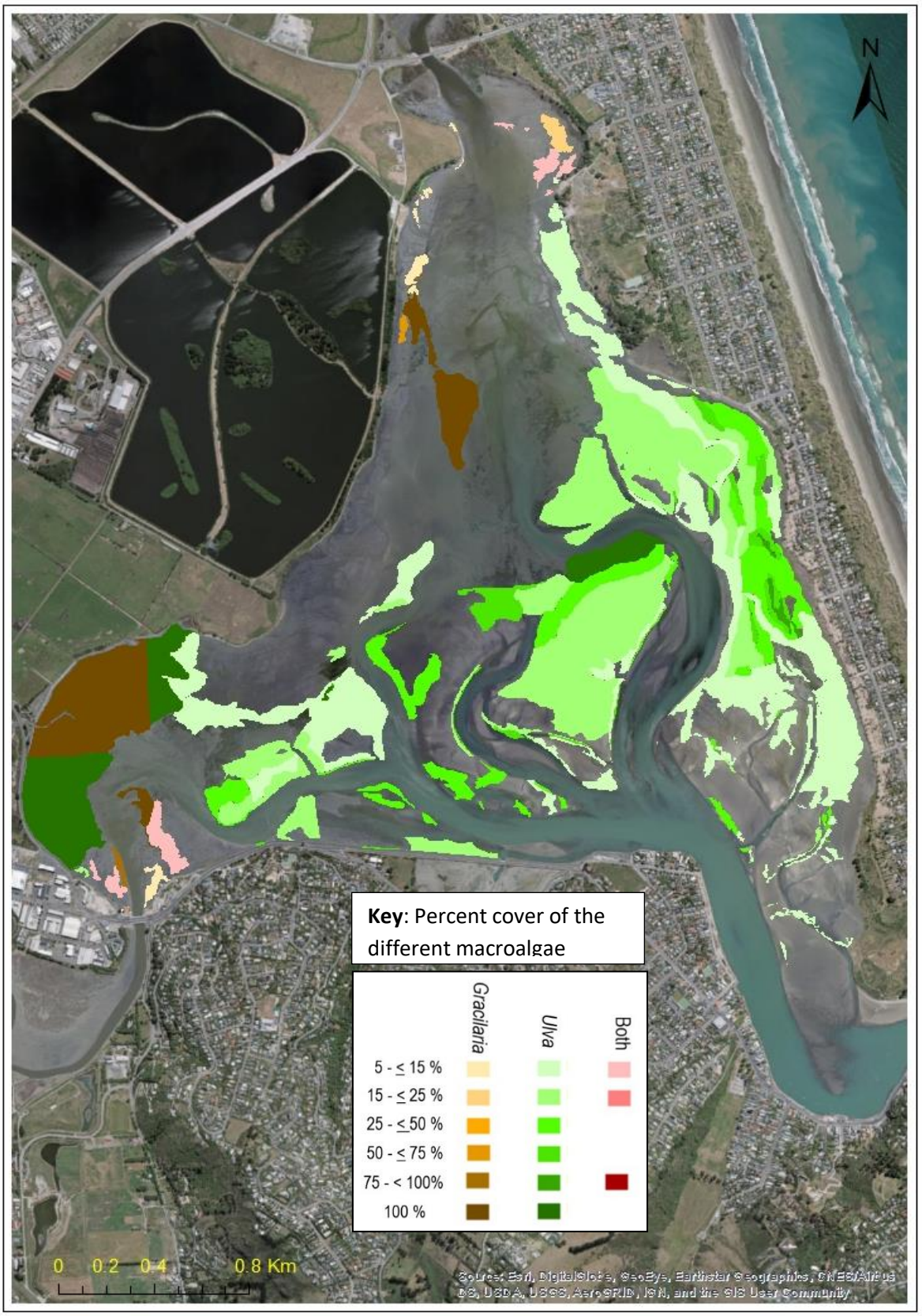

Figure 3: Distribution of macroalgae through the estuary (Bolton-Ritchie 2020, Figure 3-4). Courtesy of Lesley Bolton-Ritchie, ECan

One of the main effects of increased nutrients in estuaries that must be monitored is the growth and spread of nuisance macroalgae including sea lettuce (*Ulva spp*.) and *Gracilaria spp*. (See Figure 3.) The prevalence of these macroalgae has changed markedly in Te Ihutai over the past 50 years (Marsden & Knox 2008, Bolton-Ritchie 2020). In an unpolluted estuary, small quantities of these macroalgae support macrofauna abundance. But in large quantities they cover the intertidal flats and deoxygenate the sediment (mud, sand), making it unsuitable for macrofauna (invertebrates – worms, pipi, cockles, hoppers, crabs, snails) to live in. Few animals survive if surface sediment deoxygenates to depths of more than 10cm. Macroalgae like *Gracilaria spp.* also trap fine sediments that can increase sedimentation. When mudflats are covered in *Ulva spp*. the birds are less able to forage for food and so may need to move elsewhere. It is important to note, however, that beds of *Gracilaria spp.* can also support high concentrations of some bird species such as waders, gulls, and waterfowl but macroalgae, notably sea lettuce, also provide habitat for some macrofauna species. In the past, high mortalities of tuangi/cockles occurred alongside the oxidation ponds because of high nutrient levels, summer temperatures, and deoxygenated sediment.

3.1.4 Sediment contaminant levels

Sediments in estuaries are usually finer than those associated with open sand beaches such as the surf beaches along Pegasus Bay. Contaminants are known to bind to fine grained sediments. Historically sediment contaminants in Te Ihutai were regarded as low to moderate compared with contaminants that pollute similar estuaries across the world. Still, the nature of sediments in Te Ihutai means they can accumulate contaminants.

Liquefaction as a result of the CES 2010-2012 brought sandy sediment to the surface in the urban rivers and the estuary. Liquefied sediment can still be seen in intertidal areas and marshes surrounding Te Ihutai. The rivers continue to bring soil (terrestrial sediment) from the catchment, particularly after heavy rain.

Trace metal levels in sediment remain high, especially in drains and restored wetlands within the Heathcote industrial area and where dredged material from areas surrounding the river was dumped into the estuary in the twentieth century. In 1988, the Christchurch Drainage Board reported that in 1982 concentrations of chromium, lead, copper, zinc, and nickel reflected the distribution of fine sediments. Higher levels were reported near the river mouths and directly in front of the Bromley oxidation ponds. Subsequent sampling at infrequent intervals suggests the levels of some elements such as lead have decreased over time, although overall sediment metal levels remained similar. Immediately after the February 2011 earthquake the metal levels in the surface sediment (that is, surface sediment diluted with liquefaction sediment) dropped and have since declined further. There have been no recent estuary wide investigations of the sediment structure and sediment metal and organic content (Mills & Williamson 1999).

Less is known about organic contaminants within estuary sediments, including emerging contaminants. Organic contaminants include pesticides, pharmaceutical products, antimicrobial and preservative products, plasticisers, UV stabilisers, polychlorinated biphenyls and polycyclic aromatic hydrocarbons. All come from different sources and exhibit specific bonding chemistry with sediments. Because there are now no direct sewage discharges from the Bromley oxidation ponds, the levels of sediment contaminants are expected to improve over time, including human wastewater tracers such as caffeine and nicotine, pharmaceutical products, and estrogenic steroid hormones.

Plastic is an increasing threat to marine ecosystems with microplastics present in the water column, sediments, and within the bodies and tissues of marine organisms. Large quantities of plastics have been collected in Te Ihutai by Estuary Trust-led community clean ups. Microplastics (particles less than 5mm in length) have been found in sediments and are known to accumulate within mussels.

Microbial contaminants were identified in sediments, water, and within the bodies of cockles, shrimp, and fish contained in samples collected for student research projects sponsored by the Estuary Trust. *E. coli* is the usual biomarker used in faecal contamination assessments (from birds and mammals, including humans). Levels exceeding those acceptable for human recreation and consumption were recorded consistently after the earthquakes because of damaged sewerage infrastructure.

An assessment of emerging contaminant concentrations would be useful given the leachate from old rubbish dumps, drainage into the estuary from industrial areas, and stormwater, which continue to enter the estuary after rain. Stormwater poses problems in the way of flooding especially when heavy rainfall coincides with a high tide.

3.2 Healthy ecosystems

3.2.1 Biodiversity

Te Ihutai, like many estuaries affected by anthropogenic change, has seen a decline in biodiversity due to the loss of habitat. Estuaries are also not static ecosystems; they characteristically undergo changes in sediment inputs and erosion, water quality and hydrology. Eelgrass beds in the estuary, for example, expanded in the 1990s and covered an extensive area on the eastern side through the 1990s, 2000s and 2010s.

Though Te Ihutai has suffered a decline in biodiversity it is still one of the most studied estuaries in Aotearoa New Zealand, with 586 species or taxa recorded. These include 149 birds, 26 fish, 235 invertebrates, 95 micro and macroalgae, 92 saltmarsh and other plants (Crossland 2020, Wildlands 2017). The high species diversity is the result of diverse habitats including freshwater and marine pelagic habitats, benthic habitats including mudflats, sand banks, shell banks, rocky and boulder outcrops and islands, intertidal lagoons, saltmarsh, saltmeadow and seagrass beds, and established river margins (Wildlands 2017, Hollever & Bolton-Ritchie 2016). Fauna include resident and migratory fish and bird species, and planktonic organisms that enter with tidal movement.

The tidal mudflats provide food for foraging birds including bar-tailed godwits, oystercatchers, pied stilts and endangered black-billed gulls. Reconstructed wetlands and islands provide high tide roosting sites for birds such as royal spoonbills. Te Ihutai was recognised as “a wetland of international significance” by the East Asian-Australasian Flyway Partnership in 2018 (www.eaaflyway.net). Migratory birds play a vital role in ecosystem health and so understanding bird habitat use is critical for the development of conservation strategies. Migratory shorebirds such as bar-tailed godwits are declining significantly, and recent research at two stopover sites along the East Asian-Australasian Flyway in China shows how extremely important tidal mudflats are for foraging by shorebirds (Mu & Wilcove 2020). This research along the Flyway underlines the importance of protecting upper tidal mudflats.

Following the CES 2010-2012, investigations of macroinvertebrate biodiversity within targeted areas suggested that, despite the earthquakes, species diversity did not decline. New habitats quickly established following the accumulation of liquefaction sediments and changes to estuary floor levels appeared to result in an increase in biodiversity for some habitats.

Vegetation also changed. Since 2013, findings from a few small-scale studies indicate a growth of saltmarsh vegetation and a regrowth of seagrass. Saltmarsh plants such as *Sarcocornia* have expanded in localised areas onto liquefaction sand (such as near Settlers Crescent at the Ōtākaro/Heathcote mouth) or advanced inland as tidal water and brackish ground water moved inland. Figure 5 shows the existing vegetation in June 2020. Based on this evidence, the **status of saltmarshes** on the estuary should be re-assessed as a matter of priority. The need for more saltmarsh habitat is confirmed by the NIWA report of June 2020 on water quality (NIWA 2020).

Other plant communities that supported important indigenous biota, however, have suffered extensive die back. *Juncus krausii* stands in the lower Ōpāwaho/Heathcote declined years before the earthquakes (Crossland 2003). Further, old growth habitats of upper saltmarsh (*Plagianthus* dominated) and tall saltmarsh (*Apodasmia* and *Juncus*) have died back in and disappeared from the lower Ōtākaro/Avon, Bexley, Raupō Bay and Rat Island Inlet areas. The *Typha angustifolia*/raupō stands at Raupō Bay, Bexley Wetland and Naughty Boys Island have also disappeared. Overall, the hope is for further increases in diversity and in habitats that provide better ecosystem services rather than a continued decline in biodiversity.

Threats to biodiversity at present include development of the estuary edge, waterfowl such as Canada geese, disturbance by predators, humans and dogs – especially dogs not under their owners' control – and human recreational activities such as windsurfing, kiteboarding, use of jet skis and drones without regard for birdlife. Such threats from human encroachment compound those from the continued loss of saltmarsh habitats.

The substantial liquefaction and uplift of large areas of the estuary bed during the CES 2010-2012 reduced the tidal prism resulting in about 20 per cent less inflow. Seismic activity tilted the estuary floor so that the intertidal area at the mouth of the Ōtākaro/Avon River dropped below sea level, whereas the mouth of the Ōpāwaho/Heathcote River rose (EOS Ecology 2011). These ruptures altered the habitats in the northern part of the estuary that are necessary for waders, swamp birds, waterfowl and seabirds to feed, roost, and breed. Along the built-up edges in its southern half, the estuary already had fewer suitable habitats for these activities.

One of the important habitat types is seagrass, currently most abundant on the eastern side of the estuary off Southshore. Seagrass provides food and habitat for numerous invertebrate and some fish species. On the southern side changes in habitat induced by the earthquakes did not pose a problem for bird life. But in the northern part the saltmarsh habitat continues to be flooded to a depth on spring tides, potentially leading to plants rotting. Bird nests constructed within this marsh vegetation can also be drowned. Roosting and feeding areas have also been lost. The replacement of saltmeadow and saltmarsh by mudflats at Bexley Wetland resulted in a small net gain as mudflats are excellent feeding habitat. (See Figure 4.) There remains a dire need to protect existing saltmarsh and to provide more safe nesting/roosting islands within the estuary catchment. Planting programmes should be established for saltmeadow and saltmarsh habitat.

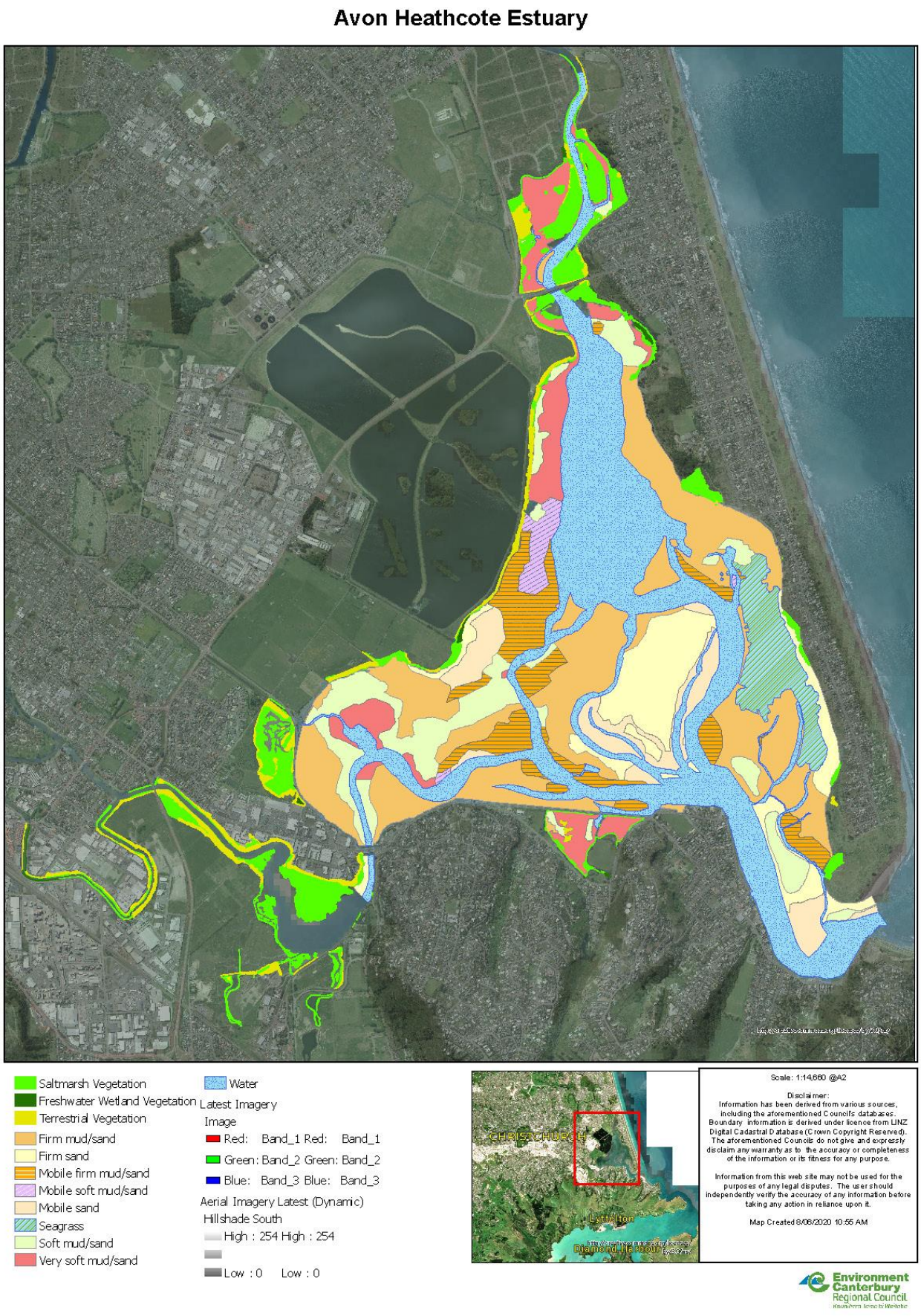

Figure 4: Map of vegetation in the estuary. Courtesy of Ecan

Habitats for indigenous fish species are also in decline. Inanga/inaka eggs laid in river and stream bank vegetation in late summer/autumn, when hatched, are carried downstream as larvae and spend the next six months at sea. In the spring inaka migrate upstream where they continue to grow into adult fish. Recent studies indicate that inaka migrate from the ocean into the estuary, rivers and streams to breed but at present there is insufficient natural marsh grass habitat for this to be successful.

For birds, the establishment of artificial wetlands and associated habitat recovery provide foraging and roosting areas for some species all year. The provision of artificial wetlands encouraged black-billed gulls to nest on the estuary from 2003 onwards; the first time in 100 years that this now endangered species nested on an estuary in the South Island. Since 2003, colonies have formed on constructed islands in Charlesworth Reserve and Bexley Wetland. These provide safe habitats, except for predation by black-backed gulls.

3.2.2 Pest species

The Wildlands Report (2017) listed exotic and native freshwater and terrestrial pest species present in the estuary. Marine pest species such as *Spartina* can be found in specific locations as well as sea lavender in the Ferrymead loop. These species are monitored, and attempts are made periodically to eradicate them. There is also potential for non-indigenous marine algae to become established as has happened in Whakaraupō/Lyttelton Harbour and around Banks Peninsula.

Pest animals around Te Ihutai include rats, hedgehogs, mice, weasels, stoats plus domestic and feral cats. Domestic cats (predation) and domestic dogs (predation, disturbance, harassment) are problems that need better community management.

Browsing and grazing animals such as rabbits pose a threat to the establishment and growth of native marsh plants. Since the Burwood landfill was relocated, black-backed gulls moved to Te Ihutai and evidence has shown that they are now a major threat to several bird species including the threatened black-billed gulls.

Some bird species can at times also be considered pests. Large and increasing numbers of Canada geese, black-backed gulls and black swans potentially contribute to the observed increase in *enterococci* counts in the estuary from 2014 to 2019 (NIWA 2020).

This Plan encourages the Christchurch City Council to continue to invest effort and financial support to increase trapping and the monitoring of pests in and around the estuary. Further research is needed on the effect of large numbers of specific bird species.

3.2.3 Loss of kaitiakitanga

Guardianship and management of the environment according to the Ngāi Tahu world view requires meeting the principles of Treaty partnership, as articulated in recent Treaty of Waitangi settlements between the New Zealand government and iwi. Locally, abiding by these principles entails respect for priorities relating to Te Ihutai as contained in the Mahaanui: Iwi Management Plan 2013 (Part 6.5). Mahaanui provides the policy framework for the protection and enhancement of Ngāi Tahu values; and outlines the desired outcomes for the relationship of Ngāi Tahu with natural resources across the area of Canterbury between the Hurunui and Hakatere/Ashburton Rivers and Te Pātaka o Rākaihautū (Banks Peninsula). This 2020 Estuary Management Plan will contribute to environmental management and kaitiakitanga within the above takiwā by protecting and restoring mahinga kai and the biodiversity of the estuary.

3.2.4 Development of the estuary edge

As the link between rivers and the sea, estuaries act as a natural buffer from storms and extreme weather. Yet development has made Te Ihutai and its margins more vulnerable to sea level rise and flooding events. Most of the southern and eastern estuary edge is no longer natural; it is hard-engineered with hard, built up edges and rip-rap walls. Sometimes rubble has been used for reclamation. Along the Southshore Spit and at Redcliffs housing is built close to this hard estuary edge, while some residents have added jetties and protruding decks. Other homeowners have illegally claimed parts of the foreshore as private property.

The southern shoreline's hard rock edges and sea walls, rebuilt after the CES 2010-2012, potentially have altered the estuary's hydrology and flow patterns beyond the changes in hydrodynamics and surface elevation precipitated by the earthquakes. The loss of margin vegetation and stretches of intertidal mudflats further reduced the foraging, roosting and nesting habitats for wading birds. Consequently, as sea levels rise with the changing climate there is nowhere for estuary habitats to migrate. The most significant implications from this loss of natural estuary margin include modification to water flows, loss of important habitats for fish and birdlife, removal of buffers to natural hazard events such as flooding, sea level rise and shoreline erosion, and contamination from uncontrolled fill used during reclamations.

The repair and strengthening of roads and construction of cycleways have contributed to the diminished extent of natural, soft edge and intertidal mudflat feeding and roosting habitat. The Estuary Trust recognises that paths built along bunds, for example, assist flood mitigation and are valuable recreational resources. But it maintains that ecological values should be prioritised "when planning recreational activities and public access to the Estuary" (Wildlands Report 2017, Executive Summary). Such works should not be built at the expense of estuary habitat or have the effect of disturbing birds at locations around the estuary shore where birds congregate. (See Section 1.2.)

3.3 Open space

3.3.1 Access and degradation of the estuary margins

The estuary margins differ markedly from how they looked before European settlement. Since 1850 natural wetlands and saltmarshes have been drained and/or filled: lost to development, roads, housing, recreational facilities, and the construction of the Bromley oxidation ponds. The outcome is a shoreline that detracts from the natural values of the estuary and decreases access to open space.

With urban development demand has grown for public access to the remaining open space. The presence of structures such as boat ramps and sea walls has further constrained access. Managing the impact on estuary ecology from public infrastructure works and from the assertion of private property rights by landowners requires greater consideration by authorities.

3.3.2 Public access

Public access to the estuary edge is essential for people's access to nature and supporting a sense of place; however, we need to identify carefully which areas need to be protected. Road reserves enabling access along the estuary edge were surveyed over 150 years ago when the emphasis was on development not ecological values. Dynamic coastal processes have since eroded some of this publicly vested land, leaving private property now directly fronting the estuary. To maintain public access in these areas is a complex issue that involves balancing the rights of the public and property owners' rights to privacy. While non-consented structures impede public access in some places, in others estuary vistas and values

have been compromised by poor planning that allowed commercial buildings on the foreshore without regard for public benefit, as at Ferrymead.

Public access should be restricted to sections of the estuary shoreline where exclusion is essential to protect wildlife, habitats, public assets and historic wāhi tapu from human disturbance and vandalism. Te Huingi Manu Wildlife Refuge in the oxidation ponds complex is a case in point. Despite signs that state there is “no through access”, Estuary Trust members and CCC staff documented that people were increasingly trespassing into the wildlife refuge along the estuary edge beside the oxidation ponds. This flouts the purpose of the wildlife refuge under the Wildlife Act. Already some birds are leaving the area. Fortunately, new gates were installed to block access in mid-2020.

People routinely ignore signs all around the estuary, especially those concerning dog control. The **CCC Dog Control Policy** requires **immediate enforcement** in areas where dogs are prohibited, such as Te Huingi Manu Wildlife Refuge, Linwood Paddocks and the adjacent estuary shoreline. Dogs must be on a leash in specific areas such as in Charlesworth Reserve and the Southshore Spit tip.

Given this documented disrespect for regulations and the mounting tensions between recreational use and the estuary’s high ecological values, the Estuary Trust strongly recommends that an **exclusion zone** is immediately established along the length of the estuary edge beside the Bromley oxidation ponds from Sandy Point to Bridge St. For 25 years ornithologists have recommended such restrictions, and the need is now urgent to safeguard the last remaining area of the estuary where birds can nest, roost and rest undisturbed (Crossland 1993, Haase 1995, Kaldor 2019, Figueiredo 2020). The exclusion zone should be accompanied by more barriers and new signage that clearly specifies “no access”. Additional public notices should also explain why this is necessary, that is, to educate people about ecological and cultural values and to encourage behavioural change.

Further, the Estuary Trust strongly recommends that **seasonal restrictions** be introduced. Both types of restriction are common tools in conservation internationally. A **winter restriction** on recreational activities on the exposed mud flats would reduce the risks of population decline, breeding failure and stress in birds that over-winter there, for example oystercatchers. Restricting human activities in the cooler months of April, May, June and July would allow birds access to “undisturbed foraging sites during their critical over-wintering and moulting period” (Haase 1995).

In summary, recreational users should enjoy the values of the estuary but not compromise the ecology. To address this, the Trust recommends that a **full-time Te Ihutai Park Ranger** is appointed to raise public awareness about the impact of human disturbance on the estuary’s ecological and cultural values and to enforce CCC by-laws.

3.4 Safe recreation

Te Ihutai provides for a wide variety of recreational activities including yachting, windsurfing, kiteboarding, fishing and shellfish gathering, picnicking, canoeing and kayaking, paddle boarding, bird watching, walking and jogging. Some uses compromise ecological values and others are incompatible. More research is needed to identify what may be deemed responsible or suitable use, and where and when, to prevent damage to the ecological and cultural health of Te Ihutai.

In recent years the high levels of unmanaged shellfish harvesting within an area of the estuary in McCormacks Bay and off Beachville Rd Redcliffs have generated widespread public concern. The Estuary Trust shares this concern. Shellfish gathering is taking place all year round, intensifying pressure on the ecosystem.

The Christchurch Coastal Pathway between Ferrymead and Sumner passes alongside the estuary giving easier access to the favoured harvesting sites. The pathway is the outcome of a community partnership between the Christchurch Coastal Pathway Group and the Christchurch City Council and is proving a popular facility for cyclists and walkers to enjoy outdoor exercise. It caters for children, pedestrians and dog walkers, cyclists, skateboarders, and people with impaired mobility. Action is needed to assess its environmental impact once the final section is completed. There is an opportunity to use the pathway to promote awareness of Te Ihutai and its ecological and cultural values.

Two sandy beaches along the Coastal Pathway route are popular sites for swimming: at the Beachville Rd jetty and at Moncks Bay on the eastern side of the Christchurch Yacht Club. At the yacht club, young people also enjoy jumping from a pontoon. Yet scientific results contained in the report on water quality (NIWA 2020) indicate that the estuary is generally unsuitable for contact recreation. The lack of suitability for swimming and the advisability of water management for shellfish gathering – both scientifically demonstrated – are topics that the Estuary Trust recommends should be addressed in the next Coastal Plan.

4 CLIMATE CHANGE

There is an urgent need for the **threats posed by the changing climate** to be incorporated into restoration planning (NOAA 2011) as evidenced by this Plan. To achieve this, the Plan must include initiatives on how to assess and incorporate sea level rise impacts into restoration planning and design for the estuary and its catchment, to predict the relative sea level rise for the estuary over 50 years using relevant data and information, and incorporate the modelled impacts into estuary management, including science and monitoring.

4.1 Sea level rise and acidification

With rising sea levels, coastal wetlands such as saltmarsh are expected to migrate landward. This migration will be constrained within Te Ihutai because it is an urban estuary with significant hard infrastructure around the edge. Eelgrass, sea rush and saltmarsh species will be squeezed out as the intertidal zone reduces in area. Fish species are expected to move with the transition in salinity, but eventually some species such as flounder, eels and inanga will lose their feeding grounds as water depths progressively increase. Wading birds will also be affected by a loss of habitat. Existing tidal mudflats will be permanently drowned and will migrate into existing saltmarsh areas so existing saltmarsh will need to re-establish at higher elevations in areas where pasture and saltmeadow currently exist.

Where there is no potential for landward migration alternative solutions will be necessary to increase the estuary's adaptive capacity, provide habitats for wildlife, and protect the surrounding suburbs from adverse storm and weather events. In areas where there is space for ecological migration, non-salt tolerant species will progressively die off with the rise in water levels and a succession to more salt tolerant species with the same vertical zonation as currently present.

Climate change is already causing ocean warming and ocean acidification. While the effects of these on estuaries are largely unknown (carbon dioxide measurement is necessary to show ocean acidification), there have been documented changes in the range shifts of fish and molluscs. Trend analyses show recent increases in water temperature in the estuary (NIWA 2020). Increased water temperatures promote macroalgae growth and hence increase eutrophication. Recent increases in water temperature may also be interacting with nutrient loads.

Marine species that are most sensitive to ocean acidification have a narrow tolerance range for environmental extremes and lack the physiological mechanisms to adapt to changing conditions. Some dominant estuarine organisms have these mechanisms and are expected to be able to adjust to climate change. Though the species present in Te Ihutai may change over time, it will be important to understand the ecological roles different species provide so that biological diversity is sustained.

Increased resilience to the effects of coastal hazards demands a collective commitment to large-scale restoration of saltmarsh and saltmeadow as well as brackish and freshwater vegetation in the estuary catchment to increase and enhance the quality of habitat for wildlife and bolster the cultural and ecological health of connected estuarine environments.

In 2019, the United Nations announced a Decade on Ecosystem Restoration from 2021 to 2030, urging governments to enact Natural Climate Solutions, that is, ecological restoration. There is potential for Te Ihutai to become a case study of actions to restore coastal ecosystems. Large-scale restoration in the estuary catchment would bestow additional climate change benefits because “the fastest accumulation of carbon occurs in … vegetated coastal habitats, such as mangroves, saltmarsh and seagrass beds. Here, carbon can be sequestered 40 times faster per hectare than in tropical forests” (Monbiot 2019).

4.2 Tidal compartment and mouth dynamics

With rising sea levels, the volume of seawater in and out of the estuary on each tide will increase and therefore will cause flooding to coastal land and at the same time increase the volume and height of the sand shoals inside and outside the entrance. With the increase in the amount of water moving in and out on each tide, it is expected that the estuary mouth channel width will change by between 40 to 50 metres. The CES 2010-2012 reduced the mouth’s width by 10-20 metres. Rising sea levels will also change the ebb-delta regime and surrounding beaches.

The Estuary Trust recommends the modelling of water residence time in the estuary to assess changes to water depth (bathymetry) since the CES 2010-2012 and the effects these changes could be having on water quality and algal growth.

4.3 Drought

During dry seasons and drought conditions the stream flows can be expected to reduce in the spring fed streams. Recharge to the aquifers will be reduced and groundwater levels can lower as a result, hence decreased outflow from the springs. Additional contributions to the streams such as surface runoff will also be significantly reduced under drought conditions.

Based on national assessments of droughts under climate change, droughts are likely to become more frequent and severe in regions that are currently drought prone, notably eastern parts of Canterbury (Mullan et al. 2005, Clark et al. 2011).

4.4 Sedimentation

Though the streams are spring fed, flooding is largely related to stormwater runoff from the urban surroundings. Climate change is expected to create more extreme weather events globally, such as flooding. Higher flood peaks due to climate change are expected for the Heathcote stream based on local assessment (Sturman et al. 2012).

5 PROTECTION MECHANISMS

Te Ihutai deserves greater protection, especially in the context of the "Climatic and Ecological Emergency" declared by the Christchurch City Council and Environment Canterbury in May 2019. Coastal ecosystems in general are in dire need of help. To provide better oversight of coastal areas nationally, the Estuary Trust would welcome the design of a proper **cohesive plan to manage coastal ecosystems** around New Zealand. Two protection mechanisms are recommended for Te Ihutai and both must be led by mana whenua if they are to be realised.

5.1 Mātaitai reserve status

The Estuary Trust supports the proposal by Ngāi Tūāhuriri – approved by the Rūnanga and endorsed by the Trust in 2019 – to obtain Mātaitai reserve status from the Minister for Primary Industries. This will ensure better management of shellfish stocks through bylaws that can set area-specific catch limits. As defined by Fisheries New Zealand, a Mātaitai reserve is an area where "tangata whenua manage all non-commercial fishing by making bylaws." A mātaitai reserve "may only be applied for over traditional fishing grounds and must be [an area] of special significance to the tangata whenua" (Fisheries NZ 2018). These bylaws apply equally to everyone. The Whakaraupō Mātaitai in Lyttelton Harbour is an example.

Despite the cultural offence caused by the city's history of discharging waste into the estuary and by the confiscation of Te Ihutai Reserve MR 900, late in 2019 Ngāi Tūāhuriri recommended obtaining mātaitai status to restore kaimoana stocks in the estuary. This recommendation is based on the following evidence:

- The 50 per cent reduction in shellfish numbers measured in 2018 compared to 2012 off the eastern end of the Causeway and Beachville Rd (Hampson et al. 2019), and continuous, unmanaged shellfish gathering since the summer of 2017-2018.
- A large increase in community requests to the Estuary Trust to stop the growing numbers of gatherers and fishers from impacting the estuarine ecosystem.

5.2 Ramsar status

A potential protection mechanism in the longer term is to gain status for Te Ihutai as a Wetland of International Importance under the Ramsar Convention, an international treaty for the conservation and sustainable use of wetlands.

A step towards that status was attained in 2018 when Te Ihutai was recognised as "a wetland of international significance" by the East Asian-Australasian Flyway Partnership. Four of the total 138 sites that hold this Flyway status are in New Zealand. This international Flyway status was awarded to Christchurch City and underlines the global significance of Te Ihutai for migratory wading birds.

New Zealand became a party to the Ramsar Convention on Wetlands in 1976. The mission of the Ramsar Convention expresses parallel values to those of the Estuary Trust, in "the conservation and wise use of

wetland through local and national actions of international cooperation, as a contribution towards achieving sustainable development throughout the world". The Trust considers that Te Ihutai is worthy of Ramsar status and would support an application once all criteria are met.

6 KEY MANAGEMENT GOALS, OBJECTIVES AND ACTIONS

To achieve each goal outlined in the Plan, a series of key objectives are defined by clear actions to be completed over the next 10 years. These actions are listed in the following Tables 1 to 5 and will be reviewed after five years or earlier if necessary.

The goals are:

GOAL 1: Communities Working Together for Better Management of the Estuary
GOAL 2: Promote Clean Water
GOAL 3: Support Healthy Ecosystems for the Estuary and its Surrounds
GOAL 4: Management of Open Space, and
GOAL 5: Safe Recreation.

In addition, the Estuary Trust will continue to promote the protection of Te Ihutai by working closely with the community and partner organisations including through the resource consent process, advocacy and resource management planning processes.

GOAL 1: Communities Working Together for Better Management of the Estuary

Objective	#	Actions	Lead and support agencies	Timeframe
Strengthen partner relationships	1.1	Continue to nurture relationship with Rūnanga and facilitate their input to board decisions.	**Estuary Trust and Ngāi Tūāhuriri**	2020-2030
	1.2	Support Rūnanga and their kaitiaki role and meet regularly with representatives.	**Estuary Trust and Ngāi Tūāhuriri**	2020-2030
	1.3	Continue to nurture relationship with Environment Canterbury through the appointment of councillor and liaison staff.	**Estuary Trust and ECan**	Ongoing
	1.4	Continue to nurture relationship with Christchurch City Council through the appointment of councillor and liaison staff.	**Estuary Trust and CCC**	Ongoing
	1.5	Renew Memorandum of Understanding with Christchurch City Council and Environment Canterbury every 10 years.	**Estuary Trust, CCC and ECan**	June 2026
	1.6	Liaise with local catchment groups to advocate and assist with ecological projects, including in-kind membership and sharing information.	**Estuary Trust/**like-minded partner groups	Ongoing
Strengthen community relationships	1.7	Organise and host public education presentations/discussions on estuary issues and subjects of interest through at least one public meeting and the AGM.	**Estuary Trust**	Annual AGM plus one other meeting
	1.8	Co-ordinate events for Seaweek, Estuary Fest, World Wetlands Day and participate in other estuary related public events.	**Estuary Trust**	Annually
	1.9	Continue to host the Trust signature event 'Farewell to the Godwits'.	**Estuary Trust, CCC Park Rangers, SSRA**	Annually
	1.10	Advocate for the recognition of traditional places and place names, support place name changes and archaeological surveys.	**Estuary Trust and Ngāi Tūāhuriri**	Ongoing
	1.11	Protect and restore areas and associated resources important to Rūnanga, may include specific native plant restoration and species of traditional significance.	**Estuary Trust, CCC and Ngāi Tūāhuriri**	Ongoing

Objective	#	Actions	Lead and support agencies	Timeframe
	1.12	Continue to inform the public about Trust activities through local newspapers such as bird of the week articles, newsletters and social media.	**Estuary Trust**	Ongoing
	1.13	Promote and make widely available the Estuary Field Guide and review every 3 years.	**Estuary Trust**	2022, 2025, 2028
	1.14	Maintain website to ensure information and research reports are easily accessible and up to date.	**Estuary Trust**	Ongoing
	1.15	Fund agreed student field projects associated with the estuary and ensure reports are available on the website and findings are presented at a public meeting.	**Estuary Trust**/ECan and Education and Research organisations	Ongoing
	1.16	Encourage community volunteers and businesses to be involved in restoration projects and events.	**Estuary Trust**	Ongoing
	1.17	Engage community in restoration projects including post-earthquake community re-vegetation projects on the estuary margin.	**Estuary Trust/**CCC Park Rangers	Ongoing
	1.18	Adopt education programmes to inform the public of the values of Te Ihutai.	**Estuary Trust**	Ongoing

GOAL 2: Promote Clean Water

Objective	#	Actions	Lead and support agencies	Timeframe
Understand state of the estuary	2.1	Continue to advocate to improve stormwater quality including sediment controls.	**Christchurch West Melton Zone Committee**/ECan/CCC/Estuary Trust	Ongoing
	2.2	Assist with public education programmes that promote awareness of actions that people can take to stop contaminants from entering stormwater.	**Christchurch West Melton Zone Committee**/ECan/CCC/Estuary Trust	Ongoing
	2.3	Lobby central and local government to reduce levels of nutrients, sediment, and contaminants in waterways to protect human and ecological health.	**Christchurch West Melton Zone Committee**/ECan/CCC/Estuary Trust	Ongoing
	2.4	Advocate to manage contaminants from old landfills.	**Estuary Trust/ECan**/CCC	Ongoing
	2.5	Advocate for assessment of contaminants of emerging concern, eg plastics, in Te Ihutai. Complete an analysis of selected organics to determine spatial distribution of contamination and to negotiate actions.	**Estuary Trust/ECan**/CCC	Ongoing
	2.6	Collect and analyse data from drains near the wastewater treatment ponds.	**ECan/CCC**	2021
	2.7	Acquire flow information for Linwood Canal.	**ECan/CCC**	2021

GOAL 3: Support Healthy Ecosystems for the Estuary and its Surrounds

Objective	#	Actions	Lead and support agencies	Timeframe
Adapt to the changing climate	3.1	Work with coastal hazard section of CCC to identify and consider bird migration corridors.	**CCC/Estuary Trust**	Ongoing
	3.2	Identify migration corridors to increase habitats and improve adaptive capacity where possible through establishment of restoration sites.	**CCC/ECan/Estuary Trust**	Ongoing
Protect and restore habitat	3.3	Support the restoration of habitat and fish passage for native fish including identifying waterways and plant specific habitat to support key species such as inanga/inaka.	**CCC/ECan/Estuary Trust/EOS**	Ongoing
	3.4	Restore the Linwood paddocks to tidal wetland and short sward lowland wet grassland. Provide volunteer assistance.	**CCC/ECan/Estuary Trust/Rūnanga**	2020-2025
	3.5	Expand Bexley wetlands and work with community groups to provide volunteer assistance.	**CCC/Estuary Trust/Rūnanga/** Community	2020-2025
	3.6	Protect and restore saltmarsh and saltmeadow within the estuary catchment, eg in the lower Ōpāwaho/Heathcote River. Provide volunteer assistance.	**CCC/Estuary Trust/OHRN/AON/**Community	2020-2025
	3.7	Plant edges of all streams entering the catchment, rivers or estuary.	**ECan/Estuary Trust**/Christchurch West Melton Zone Committee	Ongoing
Effective control of pest species	3.8	Prepare a pest (animals and plants) control strategy.	**CCC**/Christchurch West Melton Zone Committee/Estuary Trust	2020-2025
	3.9	Work with CCC to expand volunteer assistance for predator control on the estuary margins.	**CCC/Estuary Trust**	Ongoing
Research and monitoring	3.10	Prepare a State of the Takiwā report to determine if the condition of sites around Te Ihutai has changed since surveys were conducted in 2007 and	**ECan/Rūnanga/**Estuary Trust	2022, 2027

Objective	#	Actions	Lead and support agencies	Timeframe
		2012.		
	3.11	Continue to assess the distribution and abundance of saltmarsh.	**ECan/research entities/**Estuary Trust	2021 onwards
	3.12	Continue with regular monitoring of Charlesworth Reserve to validate the value and success of wetland restoration.	**Estuary Trust**	2020, 2025, 2030
	3.13	Identify distribution of seagrass and monitor the natural expansion including potential for planting.	**CCC/**Estuary Trust/EOS	2022, 2027
	3.14	Identify the effects of human disturbances on marine fauna through specific research projects.	**Estuary Trust/research entities**	Ongoing
	3.15	Evaluate and monitor the effectiveness of habitat restoration programmes.	**CCC**/ECan/Estuary Trust	2025, 2030
	3.16	Assess the impact of Canada geese, black-backed gulls and swans on habitat and water quality and the impact of grazing on seagrass.	**CCC/ECan/Estuary Trust**	Priority
	3.17	Initiate experimental tuangi/tuaki/cockles seeding and complete an assessment of cockle recruitment in the estuary.	**ECan**/MPI/Estuary Trust/research entities	2023-2025
	3.18	Support long-term, systematic ECan and CCC monitoring programmes to assess water quality, estuary sediments and biota, and whether fish and shellfish are safe to eat.	**ECan/CCC/CPH/**Estuary Trust	2021-2030
	3.19	Monitor distribution and abundance of macroalgae *Ulva* and *Gracilaria spp.*	**Estuary Trust/ECan/research entities**	2020, 2025
	3.20	Model water residence time to assess changes to water depth (bathymetry) and the effect on water quality and algal growth.	**ECan**	2023
	3.21	Advocate for the analysis of sediment structure and heavy metal contamination. Support ECan monitoring programme for sediment quality.	**ECan/**Estuary Trust	Annually

GOAL 4: Management of Open Space

Objective	#	Actions	Lead and support agencies	Timeframe
Minimise disturbance to habitats	4.1	Ensure that the design of coastal mitigation proposals upholds ecological values eg South Brighton and Southshore.	**CCC**/Estuary Trust	Ongoing
	4.2	Advocate for exclusion zone from Sandy Point to Bridge Street to protect bird habitat and wāhi tapu and marshes from human disturbance.	**Estuary Trust**/CCC/ECan/Community	Priority
	4.3	Advocate for areas of seasonal restrictions on recreational activities on mudflats.	**Estuary Trust**	Priority
	4.4	Ensure all leisure activities are in appropriate places to minimise bird disturbance.	**CCC/Estuary Trust**	Priority
Advocate for regulation to protect habitat	4.5	Advocate strongly to enforce bylaws for dog control.	**Estuary Trust/CCC**	Priority/ongoing
	4.6	Advocate strongly to enforce restricted access.	**Estuary Trust/CCC/Waste Management**	Priority
	4.7	Advocate for the removal of illegal structures in the CMA.	**Estuary Trust/CCC**	Ongoing
	4.8	Oppose any new physical barriers or engineering works that alter the estuary's natural edge. Oppose reclamations; make submissions and present at hearings against any proposals of these kinds.	**Estuary Trust/ECan/CCC**/Christchurch Coastal Pathway Group	Ongoing
	4.9	Support mana whenua in their application for Mātaitai status for Te Ihutai.	**Ngāi Tūāhuriri**	2020-2022
	4.10	Advocate to restore fish/tuna passage in streams entering catchment waterways.	**Estuary Trust/like-minded partner groups/research entities**	Ongoing

GOAL 5: Safe Recreation

Objective	#	Actions	Lead and support agencies	Timeframe
Manage tension	5.1	Manage the tension between inappropriate recreational use and protecting ecological values by better quality planning of projects that affect the estuary, more effective monitoring and containment of recreational activities, and adherence to sustainability principles.	**CCC**	Ongoing
	5.2	Advocate for the appointment of a full-time Te Ihutai Park Ranger.	**Estuary Trust**	Ongoing
	5.3	Advocate for improved water quality to meet contact recreation standards.	**Estuary Trust**	Ongoing
	5.4	Advocate to use the Coastal Pathway to promote awareness and to educate the public on the ecological and cultural values of Te Ihutai.	**Estuary Trust**	Ongoing

7 ACKNOWLEDGEMENTS

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9 GLOSSARY

Ammoniacal nitrogen: (NH3-N), is a measure for the amount of ammonia, a toxic pollutant often found in landfill leachate and in waste products, such as sewage, liquid manure and other liquid organic waste products.

Biota: The total collection of organisms of a geographic region.

Catchment: Refers to the total area from which a river collects surface water runoff.

Coastal Marine Area (CMA): The area of the foreshore and seabed:

A) Of which the seaward boundary is the outer limits of the territorial sea; and

B) Of which the landward boundary is the line of mean high water springs, except that where that line crosses a river, the landward boundary at that point shall be which be whichever is the lesser of:

i. one kilometre upstream from the mouth of the river or;

ii. the point upstream that is calculated by multiplying the width of the river mouth by five.

Contaminant: Includes any substance (including gases, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat:

i. when discharged into water, changes or is likely to change the physical, chemical or

ii. biological condition of water; or when discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged.

Dissolved reactive phosphorus: The soluble form of the nutrient phosphorus, which is readily available for use by plants.

Ecosystem: Plants, animals, their physical environment, and the dynamic processes that link them.

Hapū: Sub-tribe, usually whānau with a common ancestor.

Kaimoana: Seafood.

Kāinga: Village, settlement.

Kaitiaki: Trustee, custodian, guardian, keeper.

Ki uta ki tai: A philosophy that reflects the Ngāi Tahu view of environmental and resource management. It is a traditional concept representing kaitiakitanga (guardianship) from the mountains and great inland lakes down the rivers to lagoons, estuaries and the sea.

Liquefaction: Intense shaking by earthquakes causes saturated, unconsolidated sediments to transform into a substance that acts like a liquid.

Mahinga kai: Food and other resources and the areas where they are found.

Rāhui: To put in place a temporary ritual prohibition, closed season, ban, reserve. Traditionally a rāhui was placed on an area, resource or stretch of water as a conservation measure or as a means of social and political control for a variety of reasons which can be grouped into three main categories: pollution by tapu, conservation and politics.

Ramsar: The 1971 "Convention on wetlands of international importance" (generally referred to as the Ramsar Convention – Ramsar was the Iranian city that hosted the convention). Twelve criteria cover four categories: ecological representativeness or uniqueness; presence of threatened, unusual, or endemic plant or animal species; value for maintaining genetic and ecological diversity; and presence of substantial numbers of waterfowl species. The core Ramsar principle is "wise use" (sustainable use). See www.ramsar.org.

Rip-rap: Rock or other material used to armour shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion.

Takiwā: Area, territory of traditional authority and mahinga kai.

Taonga: Treasured possessions; includes both tangible and intangible treasures, for example, the Māori language.

Tipuna: Ancestor (tīpuna, ancestors).

Turbidity: The cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye.

Wāhi tapu: A sacred place or site that is subject to long-term ritual restrictions on access or use.

Whānau: Extended family.