

MAHINGA KAI AND ECOLOGICAL RESTORATION PLAN FOR RANGITATA HĀPUA, RANGITATA RIVER, SOUTH CANTERBURY



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Gravel barrier and hāpua lagoon with vegetated islands in the background. 8 July 2021.

Contract Report No. 5920e

March 2022

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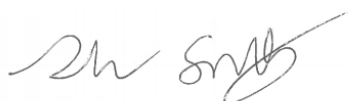
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1. INTRODUCTION

The Rangitata River and its catchment have been identified as a priority under the Department of Conservation Nga Awa source to sea restoration programme¹. The programme will provide a multi-agency approach to managing the Rangitata River. The agencies involved include the Department of Conservation, Te Rūnanga o Arowhenua, Fish and Game – Central South Island Lakes, Ashburton District Council, Timaru District Council and Environment Canterbury and they have formed a steering group (the Rangitata Steering Group) to oversee the restoration work. The Rangitata Steering Group has identified six sites within the lower Rangitata River catchment as initial priorities for restoration, and commissioned Wildland Consultants Ltd to develop high level ecological and mahinga kai restoration plans for these sites.

This report provides a restoration plan, to be implemented over a four-year timeframe, for the Rangitata hāpua, situated at the Rangitata River mouth. Wildlands has prepared similar plans for the five other Rangitata sites: Coldstream 1, Coldstream 2, McKinnons Creek, Ealing Springs, and the main stem of the Rangitata River.

2. SITE GOALS

Overarching project goals and objectives are needed to provide guidance for the ecological restoration works at the Rangitata hāpua. These goals have been aligned with those identified by the Rangitata Steering Group.

2.1 Ecological restoration project goals

- To implement a robust ecological restoration plan that will increase the mauri and ecological integrity of the hāpua.
- To increase the diversity and abundance of indigenous plant and animals that are important mahinga kai resources at hāpua.
- To build a better understanding of the hydrological and geomorphic processes at the site to safeguard the hāpua from future sea level rises and other climate change impacts.
- The integral role that Te Rūnanga o Arowhenua play as kaitiakitanga over the Rangitata River is respected and incorporated in the restoration plan and project.

2.2 Ecological restoration project objectives

By the end of the four-year timeframe of the project, the following will be achieved:

- Detailed ecological surveys have been completed and there is a high degree of understanding regarding the ecological values that are present at the site.
- Critical spawning and nesting habitat for indigenous avifauna and fish will be protected and enhanced.

¹ See: <https://www.doc.govt.nz/our-work/freshwater-restoration/nga-awa/>

- Feasibility planning for undertaking earthworks to divert river channels to protect natural spring-fed streams has been undertaken and, where possible, been implemented.
- Target areas for restoration plantings have been completed. This will include vegetation types such as coastal forest that are rare on the lower Canterbury Plains, as well as those that provide mahinga kai resources for Te Rūnanga o Arowhenua.
- Threats that can be feasibly managed at the site (e.g. pest plants and animals) are being actively addressed in cost effective ways.
- The morphodynamics of the hāpua under both current and future climates are understood, and catchment level actions implemented to safeguard these processes.
- Presently absent mahinga kai species have been translocated to the site following Department of Conservation protocols and Te Rūnanga o Arowhenua tikanga, and feasibility planning for harvestable areas of these species (e.g. harakeke and raupō).
- Ongoing management decisions are informed by a robust monitoring programme that is implemented at appropriate timeframes.
- The ecological importance of the site is highlighted to the wider community through public engagement (e.g. volunteer planting days, website updates).

3. METHODS

Ecological and mahinga kai values, threats and restoration opportunities that are present at the Rangitata hāpua site were identified by the Rangitata Steering Group and provided as written summaries.

Additional information was gathered during a site meeting on 8 July 2021. Participants included two Wildlands ecologists, representatives from the Department of Conservation, Te Rūnanga o Arowhenua, and Environment Canterbury. The purpose of these meetings was to discuss the key attributes and opportunities for restoration at the hāpua. Only the south hāpua barrier and lagoon, the south berm and associated willow nursery, and spring-fed streams and islands were visited. A second brief site visit was made by Wildland's ecologists and representatives from the Department of Conservation to the north hāpua on 9 July 2021. The hāpua was not surveyed in detail during the field meeting but, where possible, vegetation and habitat types, and potential restoration areas were mapped on aerial photos.

4. SITE DESCRIPTION

The Rangitata hāpua site consists of two areas (south hāpua and north hāpua) situated at the mouth of the Rangitata river (Figure 1). It comprises a narrow coastal lagoon, landward of a sand and gravel barrier and adjacent riparian land; low gravel islands through which spring-fed streams flow; adjacent river berm on the south-side of the river; and an area of gorse (*Ulex europaeus*) inland of the lagoon on the northern side of the river. In total, approximately 60 hectares of the site were considered as part of this restoration project area. Land tenure is a mix of Department of Conservation, LINZ Environment Canterbury and River Protection Reserve.

5. ECOLOGICAL VALUES

5.1 Vegetation and habitats types

Eight vegetation and habitat types were identified during the site visit and from aerial imagery. Further field surveys are needed to identify additional vegetation and habitats, and the species they contain at the site. The vegetation and habitat types are listed below. Descriptions of these types, and their distribution, is provided in Appendix 1.

1. Radiata pine forest (shelterbelt).
2. Poplar and crack willow forest.
3. Blackberry and old man's beard vineland.
4. Indigenous shrublands.
5. Gorse and Scotch broom shrubland.
6. Exotic grassland.
7. Gravel- and sandfield (including gravel tracks).
8. Streams, rivers and lagoons.

5.2 Notable habitat

Hāpua are a distinctive habitat of braided river systems. They are a unique coastal estuary type characterised by long narrow, shallow and predominately freshwater lagoons at least partially enclosed by a gravel barrier beach, estuary mouth with episodic closure, and a dynamism controlled by the balance between freshwater inflows and coastal processes. Hāpua are uncommon landforms globally, and a distinctive component of the natural character of the Canterbury coastline. In New Zealand, hāpua are associated with high recreational, ecological and cultural values (Eder *et al.* 2011). Hāpua are recognised as having significant landscape values, and as the end point of the river they are excellent indicators of catchment ecosystem health and the state of the mauri of the river. Due to its highly dynamic nature, the Rangitata River hāpua supports little wetland vegetation. However limited areas of freshwater marsh along the margins, and an adjoining area of estuarine saltmarsh habitat are present and the wetland values of the hāpua is considered of high significance in the Canterbury Region (ECan, 2010).

5.3 Notable flora

Indigenous flora recorded during the site visit included tī kōuka (*Cordyline australis*), rārahu/bracken (*Pteridium esculentum*), harakeke (*Phormium tenax*), kōhūhū (*Pittosporum tenuifolium*), pūrei (*Carex secta*), swamp kiokio (*Parablechnum minus*), and salt marsh ribbonwood (*Plagianthus divaricatus*). Further surveys are needed to map the distribution of other indigenous plant species at the site.

Pingao (*Ficinia spiralis*; At Risk – Declining as per de Lange *et al.* 2018) has been identified as a potential restoration species at the site. However, there is minimal sand dune habitat within the project area, which may greatly limit the restoration potential of this species at the site. For example, this species requires a sandy substrate and burial by wind-blown sand to thrive. No suitable habitat was observed during the site visit.

5.4 Avifauna

The Rangitata hāpua is a regionally-significant habitat for native sea and coastal bird species. It supports a diversity of species including shags, waders, waterfowl, gulls and terns (Brad Edwards, Department of Conservation, pers. comm. 2021). The hāpua is known to provide feeding and roosting habitat for Threatened and At Risk (as per Robertson *et al.* 2021) tarāpuka/black-billed gull (*Larus bulleri*; At Risk – Declining), tara piroe/black-fronted tern (*Chlidonias albostratus*; Threatened – Nationally Endangered), ngutu parore/wrybill (*Anarhynchus frontalis*; Threatened – Nationally Increasing), tūturiwhatu/banded dotterel (*Charadrius bicinctus bicinctus*; At Risk – Declining), and tara/white-fronted tern (*Sterna striata*; At Risk – Declining) (O’Donnell 2000). Caspian terns (*Hydroprogne caspia*, Threatened – Nationally Vulnerable) and variable oystercatcher (*Haematopus unicolor*, At Risk –Recovering) may also nest in habitats surrounding the hāpua. Large colonies (often collectively exceeding 10,000 birds) of black-billed gull, white-fronted tern, and in some years black-fronted tern nest along the coastal bar and lagoon (Brad Edwards, Department of Conservation, pers. comm. 2021). In recent years, anglers have reported that the numbers of birds in the colonies have sharply declined, potentially due to reduced common smelt (*Retropinna retropinna*) runs.

Thirty-two indigenous and 16 exotic bird species were recorded on eBird within 10 kilometres of the project area (species listed in Appendix 2). In addition to the species listed above, tōrea/South Island pied oystercatcher (*Haematopus finschi*; At Risk – Declining), karuhiruhi/pied shag (*Phalacrocorax varius varius*; At Risk – Recovering), kawau/black shag (*Phalacrocorax carbo novaehollandiae*; At Risk – Relict), little shag (*Phalacrocorax melanoleucos brevirostris*; At Risk – Relict), spotted shag (*Stictocarbo punctatus punctatus*; Threatened-Nationally Vulnerable) and tarāpunga/red-billed gull (*Larus novaehollandiae scopulinus*; At Risk – Declining) are likely to be present, at least periodically, at the Rangitata hāpua site.

5.5 Freshwater fauna

The hāpua provides habitat for a wide variety of indigenous fish species, including diadromous species that spend part of their lifecycle at sea. Surveys, conducted in November 2020, recorded the presence of more than 12 indigenous fish and aquatic invertebrate species in the Rangitata hāpua (Pattle Delamore 2021) (threat status as per Dunn *et al.* 2018, Grainger *et al.* 2018):

- Bluegill bully (*Gobiomorphus hubbsi*; At Risk – Declining).
- Common bully (*Gobiomorphus cotidianus*; Not Threatened).
- Flounder sp. (likely to be black flounder, *Rhombosolea retiaria*; Not Threatened).
- Giant bully (*Gobiomorphus gobioides*; At Risk – Naturally Uncommon).
- Īnanga (*Galaxias maculatus*; At Risk – Declining).
- Longfin eel (*Anguilla dieffenbachii*; At Risk – Declining).
- Paratya (*Paratya curvirostris*; Not Threatened).
- Shortfin eel (*Anguilla australis*; Not Threatened).
- Smelt (both common smelt (*Retropinna retropinna*; Not Threatened) and Stokell’s smelt, *Stokellia anisodon*; At Risk – Naturally Uncommon) have been recorded in the Rangitata hāpua).

- Torrentfish (*Cheimarrichthys fosteri*; At Risk – Declining).
- Upland bully (*Gobiomorphus breviceps*; Not Threatened)
- Yelloweye mullet (*Aldrichetta forsteri*; Not Threatened).

In addition, there are records of piharau/lamprey (*Geotria australis*; Threatened – Nationally Vulnerable) on the New Zealand Freshwater Fish Database.

The hāpua is known to provide critical habitat, including for spawning, for black founder, giant bully, īnanga, and stokell's smelt. The hāpua is essential for the migration of fish up and down the river. The hāpua also supports an important recreational fishery for brown trout (*Salmo trutta*) and chinook salmon (*Oncorhynchus tshawytscha*). Appendix 3 outlines the habitat value for each of the indigenous fish species that have been recorded at the site.

5.6 Other fauna

Red katipō spiders (*Latrodectus katipo*; At Risk – Declining as per Sirvid *et al.* 2021) are present at the site (Been 2010).

6. CULTURAL VALUES

6.1 Significant sites

The hāpua and its immediate vicinity contains many culturally significant sites, including kāika nohoanga (settlement sites), pā tawhito (historic pā sites) and urupā (burial sites), and is therefore of very high importance to Te Rūnanga o Arowhenua (Tipa and Associates 2015).

6.2 Mahinga Kai

The hāpua is a very important site historically for the collection of a range of mahinga kai resources that include, īnanga, piharau, tuna and harakeke. The streams on the southern side of the site are important īnanga harvesting areas. The site has been identified as a potential site for the reintroduction of other mahinga kai species including kākahi/freshwater mussel, and kōura/freshwater crayfish. Appendix 4 provides a list of six species that could potentially be reintroduced or restored at the site. Testing of mahinga kai to ensure safety should be conducted before harvest (e.g. heavy metal contamination of freshwater mussels or watercress).

7. ECOLOGICAL THREATS

7.1 Catchment level impacts

The wider Rangitata River is one of the largest braided rivers in Canterbury, extending 1,773 kilometres. The management of the wider catchment will directly impact the mouth of the river. Factors such as increased water abstraction, the increased intensity and frequency of flooding due to climate change, elevated fishing pressure, nutrient enrichment from further agricultural intensification and the spread of new invasive

plant species could impact the braid plain, barrier bank and hāpua at the site. These changes could negatively affect the indigenous plants, vegetation communities and fauna, and associated mahinga kai values, that occur within the site.

7.2 Loss of water quality

Monthly monitoring at the hāpua, undertaken by Environment Canterbury, indicates that water quality within the river mouth is of moderate to good quality (see Instream 2019 p.8 for further details). However, bio-available nitrogen increases along the downstream extent of the river, likely as a result of nutrient and effluent run off from agriculture. Further agricultural intensification, lower water levels (and associated increases in water temperatures and algal colony formation), and increased sedimentation due to factors such as the loss of vegetation cover along the length of the catchment could have significant impacts on water quality at the hāpua.

7.3 Erosion of habitat by river dynamics

Although braided rivers are highly dynamic environments, changes in the course of the river, and especially the main stem, could impact the indigenous biodiversity habitats at the site. This is particularly the case for the areas in the western-most unit of the site, as changes in the direction of the main stem could eliminate the spring-fed stream channels and the areas of open gravelfield. Similarly, declining water levels within the streams that flow into the lagoon in the eastern unit could result in the reduction of water quality and the extent of this important aquatic habitat. Although dynamism of the river system (e.g. high flow events) can threaten existing sites it is a natural process and will have creative as well as destructive, impacts on the hāpua. Therefore the greater threat to habitats is posed by extrinsic factors that prevent natural colonization and succession by indigenous biodiversity following high flow events.

7.4 Changes in hāpua morphodynamics and water levels due to climate change

NIWA climate change modelling predicts that the eastern South Island will have progressively hotter, dryer summers over the next 35 years due to global climate change (NIWA 2021). This could potentially result in lower mean annual flow rates within the river. Conversely, the frequency and intensity of seasonal rainfall events and associated flooding may lead to increased seasonal changes to the extent and morphology of the lagoon, rivers, braid plain and beach, which could impact, either negatively or positively, the available habitat for indigenous flora and fauna.

7.5 Over harvesting and disturbance of indigenous fauna

The Rangitata River is one of the five most fished rivers in New Zealand. Whitebaiting and angling for exotic fish species are focal activities within the hāpua. The activity of anglers and general beach users (e.g. vehicles and foot traffic, dogs) may be leading to the disturbance and destruction of indigenous fauna (particularly ground nesting birds and their eggs and nestlings) and damage to indigenous vegetation at the site. The impacts of whitebaiters on stocks of indigenous galaxiid species within the Rangitata River are unknown.

7.6 Pest plants

Invasive plants (pest plants) are a primary threat to wetlands and braided river habitats and the indigenous fauna species they support (Maloney *et al.* 1999). Pest plants colonise the braid plain, forcing the river to channelise. This can lead to more frequent flooding of bird breeding habitat, and reduce the number of gravel islands available for breeding. In addition, the pest plants at the hāpua will directly compete with existing areas of indigenous vegetation and restoration plantings, inhibit the recruitment of indigenous seedlings and saplings, and act as a propagule source for nearby areas.

Thirteen environmental pest plants¹ present at the hāpua/estuary are listed in Appendix 3. All of these species should be controlled within the site as time and finances allow. Six of the environmental pest plant species recorded at the site are included in the Canterbury Regional Pest Management Plan 2018-2038 (Environment Canterbury 2018).

False tamarisk (*Myricaria germanica*) and yellow flag iris (*Iris pseudoacorus*) are present on the gravel are two species that should be targeted for eradication

7.7 Pest animals

Introduced mammal species are likely negatively impacting indigenous vegetation and the population density and persistence of terrestrial indigenous vertebrate and invertebrate species at the site. This is a cumulative pressure given indigenous fauna are restricted at this site by habitat availability. Specifically, the pest animals may be having the following impacts:

- Rats (*Rattus* spp.), mustelids (*Mustela* spp.), feral cats (*Felis catus*), brushtail possums (*Trichosurus vulpecula*) and European hedgehogs (*Erinaceus europaeus*) are likely to be negatively impacting the population density and persistence of terrestrial indigenous fauna. Brushtail possums can also negatively impact indigenous vegetation.
- Rabbits (*Oryctolagus cuniculus cuniculus*), hares (*Lepus europaeus*) and possums may be impacting indigenous flora at the site.
- Feral pigs (*Sus scrofa*) may periodically occur within the corridor of the Rangitata River, and therefore may access the hāpua site. Pigs are known to consume indigenous fauna (including ground nesting birds, fledglings and eggs) and can cause considerable damage to the margins of wetlands and streams. Feral goats (*Capra hircus*) and deer (most likely red deer; *Cervus elaphus scoticus*) are less likely to occur at the site due to the presence of the nearby settlements.

In addition to the pest animals listed above, domestic dogs (*Canis familiaris*) may wander into the site from the adjacent settlements, and could potentially impact indigenous ground nesting birds.

Southern black-backed gull/karoro (*Larus dominicanus dominicanus*; Not Threatened) are known to prey on the eggs and chicks of several Threatened or At Risk indigenous

¹ Pest plant species that are known to have demonstrable negative impacts.

species that breed in braided river habits, including black-fronted tern/tarapirohe, black-billed gull/tarāpuka, wrybill/ngutu pare, and banded dotterel/tūturiwhatu, having a negative impact on their fledging success (Bell and Harborne 2019). Although black-backed gulls/karoro are an indigenous species, they occur at artificially high abundances because of human modified land use.

8. MANAGEMENT ACTIONS

The following sections outline management actions¹ required to achieve the goals and objectives listed in Section 2. They encompass the entire site which is split into management units, and are presented in order of priority. Therefore if funding is limited and time is constrained, actions can be scaled back or selected habitats prioritised. Management actions targeting avifauna and freshwater fish values, weed control to maintain and enhance river dynamism, and plantings to establish propagule supplies of indigenous species characteristic of hāpua environments are priorities. A workplan summarising the priority management actions, and areas, is presented in Appendix 7.

8.1 Identify management units

To facilitate the timely implementation of management actions we have broken the wider site into two management units (Figure 1). These management units could potentially be further subdivided in the future in line with available resources. Section 9 summarises the potential actions within these management units. Section 12 provides a suggested four-year workplan to achieve the actions.

8.2 Identify key habitats for indigenous fish and undertake habitat restoration

Freshwater fish surveys and habitat mapping should be undertaken throughout the project area to determine areas of habitat for species such as Stockell's smelt, īnanga, and giant bully. These surveys should particularly focus on the spring-fed streams in the western unit of the site, and the lagoon to determine their importance to īnanga and other indigenous fish species as spawning sites. Ecological restoration of the margins of the streams and suitable areas on the northwest margin of the lagoon should be undertaken to improve spawning habitat if indigenous galaxiid species are present. The specific details regarding the implementation of this restoration, and the species to be planted are provided in Appendix 6. At the time of the site visit (July 2021), woody weed control had been undertaken along the margins (within 10 metres) of the easternmost stream in Management Unit A in preparation for planting with indigenous species.

The diversity of habitats for indigenous freshwater fish and invertebrates within streams could be increased by adding dead wood (large logs, piles of smaller logs) of non-invasive tree species or areas of boulders (as per Richardson and Taylor 2002). Depending on the overall structure of the instream materials, these sites may also provide roosting areas for aquatic bird species.

¹ Resource consent are required for some proposed actions within this site.

8.3 Maintain opening of lagoon for fish passage

The mouth of the lagoon should remain open during key indigenous fish migration periods. This will require ongoing monitoring and maintenance, and the guidance of freshwater ecologists and coastal geomorphologists.

8.4 Control exotic shrublands within sections of the braid plain to create additional ground-nesting bird habitat

Exotic shrublands and grassland within sections of the braid plain in the western-most area of the site could potentially be controlled to create open braid plain habitat for ground-nesting birds. This would require the spraying of the areas of shrubland and grassland, and the subsequent clearance of the vegetation using earthmoving equipment. The vegetation that is removed would need to be transported to an approved dumping site. Pest plant control will need to be undertaken on an ongoing basis to limit the reestablishment of exotic vegetation.

8.5 Enhance habitat for indigenous fish and ground nesting birds in areas adjacent to the project site

A survey is needed to determine if inanga and other indigenous galaxiids utilise the small tributary streams that are present in the braid plain immediately upriver of the site. If present, and if the spring-fed streams in the project area do not provide significant habitat for indigenous galaxiids, restoration could be undertaken along the margins of these streams to enhance the spawning habitat.

There is considerable scope to improve indigenous bird nesting habitat within the open areas of braid plain between the two management units. If not already implemented, the targeted deployment of traps for pest mammals could be undertaken immediately prior to and during the nesting season of key indigenous ground-nesting species. Monitoring of nesting and fledgling success rates of key bird species and pest animals should be undertaken alongside the pest mammal control work.

8.6 Undertake pest mammal control to enhance indigenous bird habitat

Pest animal control should only be implemented at the site if these areas are considered suitable bird nesting habitat. In addition, these areas are likely to experience high levels of human activity, and therefore may require the management of public access (e.g. cordoning off, signage) to prevent disturbance of nesting birds.

If targeted pest animal control is considered feasible, this could potentially be undertaken in areas of braid plain where exotic shrubland is cleared (as per 8.7) as well as on the barrier beach during the periods of the year when ground-nesting birds are present (typically between August and February). This trapping would ideally extend over suitable braid plain and beach habitat beyond the project area.

The targeted pest animal control would use standard techniques such as trapping with DOC 200 series traps. The exact scale of trapping would be dependent on the amount of habitat that becomes available following weed clearance. Traps that are placed in

sections of the braid plain that flood during the winter will need to be deployed prior to the nesting season and then retrieved before the proceeding winter.

8.7 Undertake karoro control to protect threatened and taonga birds

It may be necessary to protect current and future colonies of threatened and taonga birds breeding on the river braids and coastal lagoon and bar from karoro predation. Karoro breeding colonies are present in the lower reaches of the Rangitata River, including around the Rangitata River mouth, and eradication of colonies around hapua may be warranted. However, control of karoro, an indigenous species, is a matter of some sensitivity, the rationale for which will need to be clearly articulated and communicated to all who live around and use the Rangitata River mouth. Data from 16 operations to control karoro indicate an average cost of \$62 dollars per bird, including some time for community consultation (Bell and Harbourne 2019). Karoro daily foraging behaviour and movement among colonies, are poorly documented for the Canterbury region, so it is not known how many colonies and at what distance, need to be controlled to achieve conservation gains for taonga species breeding at the Rangitata River mouth and lagoon. Karoro control is likely to be a complex operation involving targeted monitoring of key success indicators (breeding success of taonga species at the site) in conjunction with an adaptive management approach until a desired threshold is reached. The Southern Black Backed Gull Strategy for Canterbury (Bell and Harbourne 2019) summarises what is currently known and understood about control options and operations, and their effects, and highlights gaps in our understanding of karoro ecology that need to be filled in order to maximise management success. The cost will be dictated by the size of the colonies to be eradicated, but could be upward of \$25K, given two colonies of 50-100 pairs were mapped in the vicinity of the Rangitata River mouth by Bell and Harbourne (2019). A staged strategy to achieving target-levels of breeding success may be to start with local colony eradication, and monitor the effect this has endemic braided river bird fledgling success, before deciding whether additional control of other neighboring colonies is required.

8.8 Undertake pest plant control for target species

Targeted pest plant control at the site should be undertaken on an ongoing basis for species that have a high likelihood of being eradicated or controlled to low levels. Based on the initial site visit, false tamarisk (*Myricaria germanica*) and yellow flag iris (*Iris pseudoacorus*) are two species that should be targeted for eradication. A detailed pest plant survey should be undertaken at this site to identify other pest plant species that have a high feasibility for control.

8.9 Establish restoration plantings of mahinga kai species

Restoration plantings of pā harakeke and raupō (*Typha orientalis*) could be planted in the areas of wetland and stream margins immediately adjacent to the beach in the southwestern-most corner of Management Unit A (Figure 1). These plantings should be undertaken in sheltered sites that are permanently damp.

8.10 Develop site- and species-specific restoration plans

The results of the fauna and vegetation surveys should be used to inform species- and site-specific restoration plans. The species-specific plans should target Threatened, At Risk and mahinga kai species (e.g. kanakana/lamprey; Threatened – Nationally Vulnerable, and kākahi/freshwater mussel; At Risk – Declining) and should be guided by Department of Conservation translocation protocols and the tikanga of Te Rūnanga o Arowhenua. Potential mahinga kai restoration species for the site are provided in Appendix 4.

8.11 Selectively restore indigenous vegetation in areas of poplar and crack willow forest

Areas of poplar and crack willow (*Salix ×fragilis*) forest in Management Unit A could be selected to trial restoration methods for use across the wider catchment. Ideally, the area of control would extend beyond the footprint of the project area to the wider margin of the wetland to the southwest of the management unit. Several restoration treatments could be applied to sections of the area that are controlled (e.g. underplanting existing canopy with and without prior canopy thinning, followed by strategic canopy removal; no planting but sustained pest plant control, no control) to better understand how management achieve restoration of indigenous vegetation within these exotic forests. The existing willow nurseries within this area should be retained.

Alternatively, this area of poplar (*Populus* sp.) and willow forest could be left in place with no management actions implemented.

8.12 Undertake restoration plantings in the areas of scrub adjacent to the lagoon

Restoration plantings could be implemented in the areas of gorse and Scotch broom (*Cytisus scoparius*) scrub in Management Unit B. These restoration plantings should be undertaken in a staged manner by mulching small areas of exotic shrubland and planting drought tolerant indigenous coastal trees and shrubs within the sheltered planting areas (see Appendix 6 for species). Ongoing pest plant control will be needed within the planting areas. Opportunities may exist to involve residents of the Rangitata Huts in these restoration plantings.

8.13 Monitor recreation pressures and implement an educational program

The impacts of recreational users at the site should be monitored on an ongoing basis to determine the effects they are having on habitats and natural resources, especially indigenous bird and fish species. Signage and a public awareness campaign will be needed to help prevent harvesting of indigenous fish and disturbance of indigenous birds if these reach unsustainable levels.

8.14 Develop a better understanding of the hydrodynamics of the river and lagoon, and the likely impacts of sea level rise

Further studies are needed to develop a better understanding of the hydrodynamics of the river and the lagoon at the site. This is particularly the case for how climate change and associated sea level rise may impact the barrier beach and lagoon. Richard

Measures (NIWA) is currently undertaking PhD research at Canterbury University to develop models to predict changes to hāpua based on data collected at the mouth of the Hurunui River. These models, once developed, may be used for predicting changes at the Rangitata River hāpua.

8.15 Develop a better understanding of the threats to the spring-fed streams and implement actions to mitigate threats.

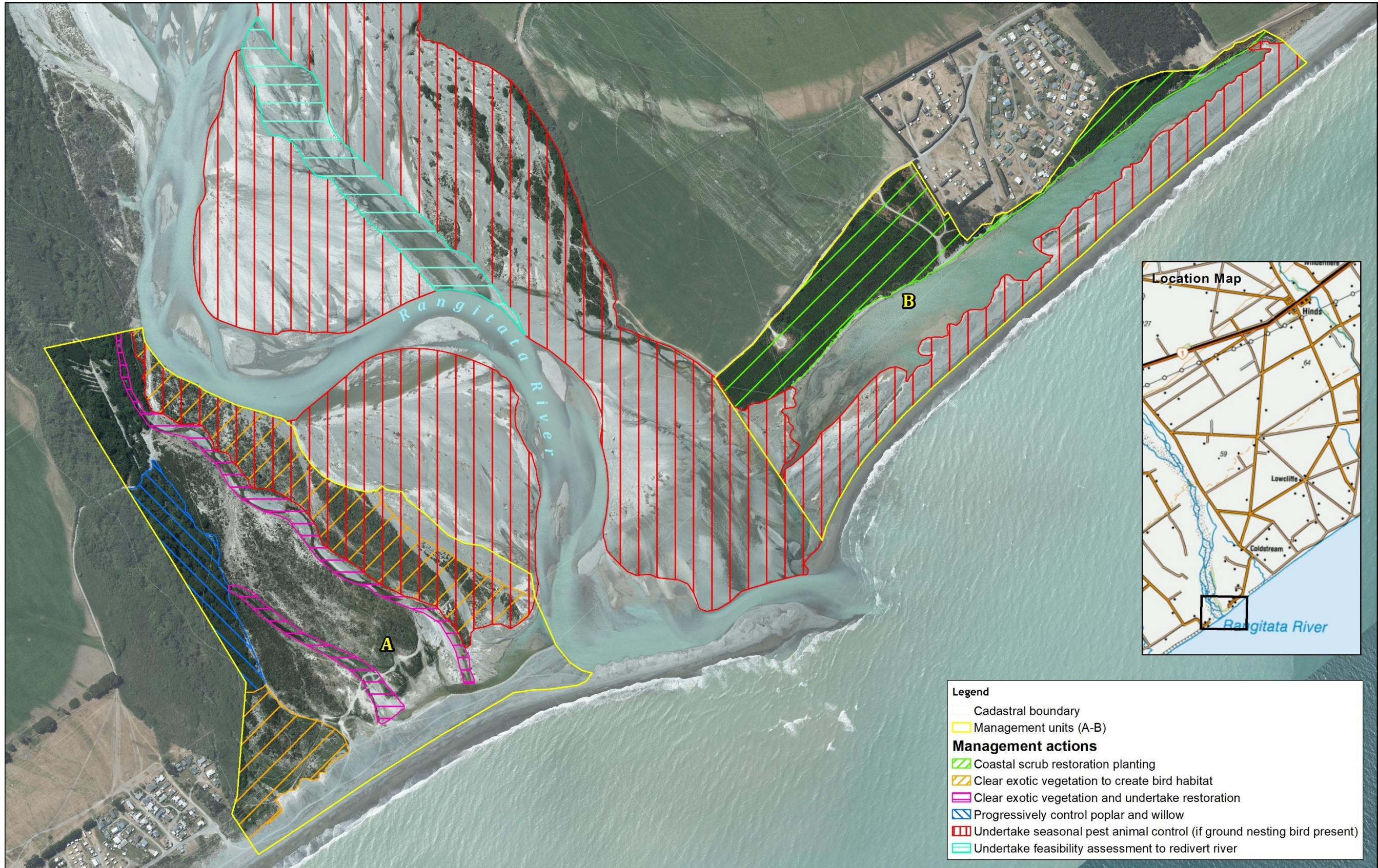
The immediate goal for spring-spread streams is to maintain flows by further remedying existing diversions, and not allowing diversions of flow in the future. A scoping study should be undertaken to identify threats to the streams and actions to safeguard these habitats.

8.16 Undertake a feasibility assessment create stopbanks or to redirect some of the flow of the main channel of the river

Temporal and spatial dynamism is an integral characteristic of the hāpua environment. Allowing for natural dynamism is critical for the sustained provision and ongoing resilience of the hāpua values. However, concerns regarding erosion of spring-fed streams by the main river channel has been raised by the Steering Group. While not compatible with the broader goals of maintaining dynamism in a braided river, protection of particular threatened values may be warranted, such as spawning streams, if they have been reduced to such a level that they are at risk of complete elimination.

To protect the spring-fed streams and surrounding gravelfield within Management Unit A, consideration could be given to excavating channels outside of the area of the project footprint to redivert some of the flow of the current main stem of the river. However, any engineering of the course of the main stem will require hydrological modelling as well as ongoing maintenance of the channel to ensure that it remains open after floods. Without ongoing investment any redirection is likely to be a short-term solution given the dynamism of the river. In addition, a resource consent will also likely be required to divert some of the flow of the river. Alternatively engineering structures could be constructed to protect key values.

Any engineering works planned for the Rangitata River hāpua should ensure that key habitats present are protected. The possibility for alignment of engineering and ecological objectives to be simultaneously achieved should be explored.



Legend

- Cadastral boundary
- ▭ Management units (A-B)
- Management actions**
- ▨ Coastal scrub restoration planting
- ▨ Clear exotic vegetation to create bird habitat
- ▨ Clear exotic vegetation and undertake restoration
- ▨ Progressively control poplar and willow
- ▨ Undertake seasonal pest animal control (if ground nesting bird present)
- ▨ Undertake feasibility assessment to divert river

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Figure 1. Management units and select management actions at Rangitata Hāpua, Rangitata River, South Canterbury



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9. ACTIONS WITHIN MANAGEMENT UNITS

Table 1 outlines the specific management actions that are required for the implementation of ecological restoration at the site.

Table 1: Ecological restoration management actions required at the Rangitata hāpua site.

Management Unit	Size (ha)	Current Vegetation and Habitat Type	Intended Vegetation and Habitat Type	Suggested Management Actions
A	34.1	<ul style="list-style-type: none"> • Poplar and crack willow forest • Blackberry and old man's beard vineland • Indigenous shrublands • Gorse and Scotch broom shrubland • Exotic grassland • Gravel- and sandfield • Stream, rivers and lagoons 	<ul style="list-style-type: none"> • Braid plain • Poplar and crack willow forest • Indigenous shrublands • Harakeke flaxland/raupō reedland • Gorse and Scotch broom shrubland • Exotic grassland • Streams 	<ul style="list-style-type: none"> • Carry out an indigenous fish species and habitat survey in select sites • Undertake restoration of riparian margins if inanga and other galaxiid species utilise the streams as spawning sites • Control exotic shrublands through sections of the braid plain to create additional ground-nesting bird habitat • Implement pest animal control throughout the year; particularly before and during key bird nesting periods • Undertake targeted pest plant control on an ongoing basis • Canopy management and restoration plantings within poplar and crack willow forest • Undertake plantings of mahinga kai species such as harakeke and raupō
B	24.3	<ul style="list-style-type: none"> • Radiata pine forest (shelterbelt) • Gorse and Scotch broom shrubland • Exotic grassland • Gravel- and sandfield • Stream, rivers and lagoons 	<ul style="list-style-type: none"> • Radiata pine forest (shelterbelt) • Indigenous scrub • Gravel- and sandfield • Streams and lagoon 	<ul style="list-style-type: none"> • Maintain the opening of the lagoon for indigenous fish passage • Carry out an indigenous fish species and habitat survey in select sites. • Undertake restoration of sections of the lagoon margins if inanga and other galaxiid species utilise these as spawning sites • Undertake targeted pest plant control on an ongoing basis • Implement pest animal control before and during key bird nesting periods • Undertake restoration plantings of indigenous coastal forest and scrub in areas of exotic shrubland north of the lagoon
Total at Site	58.4			

10. MONITORING

Monitoring should be regularly undertaken at the site to inform and improve the implementation of management actions. The monitoring should be carried out throughout the four-year project and continued on an ongoing basis thereafter.

Photopoints

Photos taken at specific points and at set timeframes, are an efficient way to monitor gross changes in vegetation composition and structure within a defined viewpoint. It is recommended that at least 10 photopoints are established at the site. The location of each photopoint should be recorded with a handheld global positioning system (GPS). A compass should be used to gauge a bearing to the center of the frame of the photopoint. The photographs should then be printed to provide a reference for future revisits. The photopoints should be resampled every year in sites where frequent management actions are occurring (e.g. ongoing pest plant control).

Pest Plants and Restoration Plantings

Monitoring visits should be undertaken at least every three months during the growing season to track the proportions of pest plants killed via control work and the survival rates of restoration plantings. Walk through transects should be established through the larger restoration areas. The results of this monitoring should be used to improve management decisions regarding factors such as herbicide choice and the density and species selection of future restoration plantings.

Natural and Reintroduced Populations of Threatened Species

All populations of naturally occurring and reintroduced threatened species should be regularly monitored to build a better understanding of their habitat requirements, determine the limitations to restoration success, and identify future management actions. The monitoring regime will vary by species and should be undertaken by biologists who have experience working with the target species. For ground nesting indigenous birds, nesting and fledging success should be monitored, and any observations of adult mortality noted.

Pest Animals

Small mammal predators (rats, mustelids, cats, hedgehogs and possums) should be monitored as part of ground-nesting bird conservation efforts at the site. Monitoring for rabbit and hare damage should be undertaken in all restoration plantings. As they mature, plantings of palatable indigenous tree and shrub species should be monitored for damage by possums. All pest monitoring should follow the best practice guidelines provided on the Bionet website (<https://www.bionet.nz/library/>).

Recreation pressure

Angler activity within key rivers (including the Rangitata River) is presently monitored through periodic surveys conducted by Fish and Game (e.g. see Fish and Game 2016).

Damage by vehicles and pedestrians at the site could be monitored using photopoints and permanent transect lines to document the area and intensity of their impact.

11. CONSTRAINTS

The successful ecological restoration of the Rangitata hāpua site is potentially constrained by a number of factors. These constraints, and their potential solutions, are outlined in Table 2.

Table 2: Potential constraints and solutions for the ecological restoration of the Rangitata hāpua site.

Potential Constraint	Potential Solutions
Lack of ongoing funding beyond the four-year timeframe	<ul style="list-style-type: none"> • Begin applying for further funding within the first two years of the project. • Hire a dedicated project manager to successfully implement the project. • Widely publicise the work of the project to build a profile and community support.
Ongoing declines in water quality due to catchment level impacts	<ul style="list-style-type: none"> • Monitor water quality on an ongoing basis. • Identify and limit the impacts of future sources of pollution on an ongoing basis through legislation and outreach.
Changes in hydrology due to water extraction or other upstream pressures, and climate change	<ul style="list-style-type: none"> • Undertake hydrological studies to determine the thresholds and threats to the geomorphic integrity of hāpua if these haven't already been completed. • Implement the management actions outlined in this report.
Over harvesting of indigenous fish species, disturbance of indigenous coastal bird species, damage of habitats at the site	<ul style="list-style-type: none"> • Undertake monitoring of catch sizes of whitebait and other indigenous fish species. • Establish and enforce exclusion zones for people and vehicles. • Install signage to inform the public about the ecological values at the site. • Involve the local community in conservation activities.
Ongoing environmental pest plant invasion	<ul style="list-style-type: none"> • Undertake ongoing pest plant control. • Ensure maintenance teams are experienced and follow best practice protocols. • Where feasible, undertake restoration in the wider area to limit the reinvasion of pest plants.
Failure of restoration plantings	<ul style="list-style-type: none"> • Only contract reputable native plant nurseries who have a track record of growing high quality plants. • Ensure planting teams are experienced and follow best practice protocols. • Only undertake plantings in stabilised areas that are less likely to be flooded during heavy rain events. • Undertake regular maintenance of plantings in the first year after planting.
Failure of species reintroductions	<ul style="list-style-type: none"> • Seek the advice of technical experts to ensure reintroductions follow best practice guidelines. • Undertake regular monitoring to inform future reintroduction efforts. • Undertake regular monitoring following species reintroductions to determine ongoing management actions (see Section 9 below).

12. TIMELINE

The following workplans outline the timeline and indicative costs for the management actions within the two management units. Within the timeline, the removal of the poplar and crack willow forest in Management Unit A is staged over three years. The removal of the gorse and Scotch broom shrubland is staged over four years. The estimated costs for pest animal control are for the areas of braid plain and barrier beach within the project footprint only. Additional areas will need to be costed separately. The timeline is contingent upon the restoration actions continuing after the initial four years. The 12 month period for the implementation of management actions within the four years begins in November 2021.

Table 3: Timeline and indicative costs for the implementation of ecological restoration actions at the Rangitata hāpua site.

Management Unit	Management Action	Timing	Price Estimate
Year 1			
Both management units	Undertake a feasibility assessment for the diversion of the main river to spring-fed streams	Throughout the year	\$30,000
	Undertake a feasibility assessment for the diversion of the main stem of the river	Throughout the year	\$40,000
	Initiate process for obtaining resource consents for river/stream diversion (if considered feasible)	Once feasibility assessment is complete	Exact costs to be determined
	Freshwater fauna and habitat survey to identify restoration areas	November 2021-April 2022	\$7,000
	Undertake modelling study to determine the possible impacts of sea level rise and changes in river flow	Throughout the year	Costs to be determined through consultation with appropriate agency. However, is likely to be \$30,000 or more
	Establish photopoints where ecological restoration will occur	November 2021-April 2022	\$1,000
	Undertake pest plant survey at the site	November 2021-April 2022	\$4,000
	Undertake pest plant control for target pest plant species	November 2021-April 2022	\$6,000
	Install pest animal control within areas of braid plain/barrier to protect ground-nesting indigenous birds	November 2021-February 2022 (check twice monthly), March-July 2022 (Check monthly)	\$12,000
	Remove traps prior to winter floods (in flood-prone locations)	March – May 2022	\$1,000
	Order eco-sourced plants and planting materials (plant guards etc.) for dryland forest, coastal scrub, riparian and mahinga kai restoration areas in Management Units A and B	November 2021	\$141,000
	Order infill plants for Year 1 plantings for both management units	October 2022	\$15,000

Management Unit	Management Action	Timing	Price Estimate
A	Undertake a feasibility assessment and control exotic shrublands within part of the old braid plain	November 2021-February 2022	\$8,000
	Remove exotic shrublands, transport dead vegetation from old braid plain and level area	February – April 2022	\$30,000
	Control a section of poplar and crack willow forest	November 2021-April 2022	\$7,000
	Prepare planting sites (dryland, riparian margins, mahinga kai restoration areas)	April 2022	\$17,000
	Undertake restoration plantings	May and June 2022	\$40,000
B	Maintenance of lagoon mouth (freshwater ecologist and coastal geomorphologists technical input)	November 2021-April 2022	\$8,000
	Mulch areas of gorse and Scotch broom shrubland for plantings of indigenous coastal scrub (section of area only)	March 2022	\$3,500
	Prepare planting sites for indigenous coastal scrub (section of area only)	April 2022	\$6,000
	Undertake restoration plantings	May and June 2022	\$13,000
Year 2			
Management units A and B	Remeasure photopoints	November 2022-April 2023	\$1,000
	Continue and complete process for obtaining resource consent for river diversion (if feasible)	Throughout the year	Exact costs to be determined
	Implement river and stream diversions	November 2022-April 2023	Exact costs to be determined. However, costs are likely to be >\$80,000
	Maintenance of lagoon mouth	November 2022-April 2023	\$3,000
	Undertake follow up pest plant control for target pest plant species	November 2022-April 2023	\$3,000
	Pest plant control within all restoration sites	Two times: November 2022, March 2023	\$9,000
	Maintain pest animal control within areas of braid plain/barrier to protect ground-nesting indigenous birds	November 2022-February 2023 (check twice monthly), March-July 2023 (Check monthly)	\$8,000
	Remove traps prior to winter floods (in flood-prone locations)	March – May 2023	\$1,000
	Order eco-sourced plants and planting materials (plant guards etc.) for dryland forest and coastal Management Units A and B	November 2022	\$58,000
	Order infill plants for Year 2 plantings for both management units	October 2023	\$5,800

Management Unit	Management Action	Timing	Price Estimate
A	Control a section of poplar and crack willow forest	November 2022- April 2023	\$6,000
	Prepare planting sites within dryland forest	April 2023	\$4,000
	Undertake restoration plantings	May and June 2023	\$9,900
	Infill planting for Year 1 planting areas	May and June 2023	\$5,000
B	Mulch areas of gorse and Scotch broom shrubland for plantings of indigenous coastal scrub (section of area only)	March 2023	\$3,500
	Prepare planting sites for indigenous coastal scrub (section of area only)	April 2023	\$5,200
	Undertake restoration plantings	May and June 2023	\$13,000
	Infill planting for Year 1 planting areas	May and June 2023	\$2,000
Year 3			
Management units A and B	Remeasure photopoints	November 2023- April 2024	\$1,000
	Maintain river and stream diversions	November 2023- April 2024	\$5,000
	Maintenance of lagoon mouth	November 2023- April 2024	\$3,000
	Undertake follow up pest plant control for target pest plant species	November 2023- April 2024	\$3,000
	Pest plant control within all restoration sites	Two times: November 2023, March 2024	\$7,000
	Maintain pest animal control within areas of braid plain/barrier to protect ground-nesting indigenous birds	November 2023- February 2024 (check twice monthly), March- July 2024 (Check monthly)	\$8,000
	Remove traps prior to winter floods	March – May 2024	\$1,000
	Order eco-sourced plants and planting materials (plant guards etc.) for dryland forest and coastal Management Units A and B	November 2023	\$58,000
	Order infill plants for Year 3 plantings for both management units	October 2024	\$5,800
A	Control a section of poplar and crack willow forest	November 2023- April 2024	\$6,000
	Prepare planting sites within dryland forest	April 2024	\$4,000
	Undertake restoration plantings	May and June 2024	\$9,900
	Infill planting for Year 2 planting areas	May and June 2024	\$2,000
B	Mulch areas of gorse and Scotch broom shrubland for plantings of indigenous coastal scrub (section of area only)	March 2024	\$3,500

Management Unit	Management Action	Timing	Price Estimate
	Prepare planting sites for indigenous coastal scrub (section of area only)	April 2024	\$5,200
	Undertake restoration plantings	May and June 2024	\$13,000
	Infill planting for Year 2 planting areas	May and June 2024	\$2,000
Year 4			
Management units A and B	Remeasure photopoints	November 2024-April 2025	\$1,000
	Maintain river and stream diversions	November 2024-April 2025	\$5,000
	Maintenance of lagoon mouth	November 2024-April 2025	\$3,000
	Undertake follow up pest plant control for target pest plant species	November 2024-April 2025	\$3,000
	Pest plant control within all restoration sites	Two times: November 2024, March 2025	\$6,000
	Maintain pest animal control within areas of braid plain/barrier to protect ground-nesting indigenous birds	November 2024-February 2025 (check twice monthly), March-July 2025 (Check monthly)	\$8,000
	Remove traps prior to winter floods	March – May 2025	\$1,000
A	Infill planting for Year 3 planting areas	May and June 2025	\$2,000
B	Mulch areas of gorse and Scotch broom shrubland for plantings of indigenous coastal scrub (section of area only)	March 2025	\$3,500
	Prepare planting sites for indigenous coastal scrub (section of area only)	April 2025	\$5,500
	Undertake restoration plantings	May and June 2025	\$13,000
	Infill planting for Year 3 planting areas	May and June 2025	\$2,000
Total			\$824,300

13. CONCLUSIONS

The Rangitata hāpua site contains a hāpua lagoon, spring-fed streams, degraded braid plain and a barrier beach, all of which are of high ecological value. In addition, the two management units of the site are dissected by the main stem and mouth of the Rangitata River. Collectively, these habitats potentially provide excellent opportunities for the restoration of threatened and mahinga kai species, as well as the enhancement of existing populations of indigenous plants and animals (e.g. tarāpuka/black-billed gull, tara piroe/black-fronted tern, ngutu parore/wrybill, bluebill bully, and īnanga).

In order to meet the Rangitata Steering Groups overarching goals of improving species recovery, habitat enhancement, and identification of opportunities for restoring mahinga kai resources at the Rangitata hāpua site, ecological values, threats and management actions have been identified. The primary threats at the site are from loss

of water quality and volume associated with catchment level impacts and climate change, changes in the course of the river and associated flooding, over harvesting and disturbance of indigenous fauna, and pest plants. Management actions include undertaking a feasibility assessment and implementing the diversion of some of the flow of the main river to the spring-fed streams, carrying out habitat restoration for indigenous fish spawning, commissioning studies to determine the likely impacts of sea level rise on the site, and creating additional ground-nesting bird habitat by controlling and removing areas of exotic shrubland on areas of braid plain. Implementing these management actions will greatly enhance the ecological integrity and mauri of the Rangitata hāpua site, and ensure that the site provides mahinga kai for Te Rūnanga o Arowhenua, and recreational resources for the wider community for future generations.

ACKNOWLEDGMENTS

Brad Edwards (Department of Conservation/Te Papa Atawhai) provided client liaison and background information on the values, threats and management opportunities for each site. Additional information was provided by Karl Jackson (Te Rūnanga o Arowhenua), Michael McMillan (Aoraki Environmental Consultancy, Te Rūnanga o Arowhenua), Angela Christensen (Fish and Game), Jayde Couper (Fish and Game), Greg Stanley (Environment Canterbury), David Owen (Environment Canterbury), Paul Eddy (Environment Canterbury), Andrew Grant (Department of Conservation/Te Papa Atawhai), and Ellery Mayence (Department of Conservation/Te Papa Atawhai).

REFERENCES

- Bell M.D. and Harborne P. 2019: Canterbury Southern Black-backed Gull/ Karoro control strategy discussion document. Unpublished Wildlife Management International Technical Report to Environment Canterbury.
- Burrows C.J. and Partridge T.R. 2008: Chapter 24. Vegetation of the coast. In: Winterbourn M., Knox G., Burrows C. and Marsden, I. (eds.) *The Natural History of Canterbury*. Third edition. Canterbury University Press. Pp. 771-790.
- De Lange P.J., Rolfe J.R., Barkla J.W., Courtney S.P., Champion P.D., Perrie L.R., Beadel S.M., Ford K.A., Breitwieser I., Schönberger I., Hindmarsh-Walls R., Heenan P.B., and Ladley K. 2018: Conservation status of New Zealand indigenous vascular plants, 2017. *New Zealand Threat Classification Series 22*. Department of Conservation, Wellington. 82 pp.
- Dunn N.R., Allibone R.M., Closs G.P., Crow S K., David B.O., Goodman J.M., Griffiths M., Jack D.C., Ling N., Waters J.M., and Rolfe J.R. 2018: Conservation status of New Zealand freshwater fishes, 2017. *New Zealand Threat Classification Series 24*. Department of Conservation, Wellington. 11 pp.

- Eder D., Faulkner J., Harris A., Hawke M., Hawker T., Hodgen M., Hughey K., Rupene M., Solomon R., Bedford D., and Dalley W. 2011: Hurunui Waiau Zone Implementation Programme. Hurunui – Waiau Zone. <https://www.ecan.govt.nz/document/download/?uri=1662786> (Accessed 10 October 2021).
- Environment Canterbury 2010: Wetland Record Sheet: Rangitata River Mouth Hapua. *Environment Canterbury*. 3 pp
- Environment Canterbury 2018: Canterbury Regional Pest Management Plan 2018-2038. *Environment Canterbury*. 129 pp.
- Fish and Game 2016: Angler usage of New Zealand lake and river fisheries: Results from the 2014/15 National Angling Survey. Report prepared by NIWA. 143 pages.
- Grainger N., Harding J., Drinan T., Collier K., Smith B., Death R., Maken T. and Rolfe J. 2018: Conservation status of New Zealand freshwater invertebrates, 2018. *New Zealand Threat Classification Series 28*. Department of Conservation, Wellington. 25 pp.
- Harding M.A. 2009: Canterbury Land Protection Strategy. Nature Heritage Fund, Wellington. 125 pp.
- Heather B.D. and Robertson H.A. 2015: The field guide of the birds of New Zealand. Penguin Books, New Zealand. 464 pp.
- Instream 2019: Rangitata River catchment conservation values. Prepared for Department of Conservation. 34 pp.
- Maloney R.F., Keedwell R.J., Wells N.J., Rebergen A.L., Nilsson R.J. 1999: Effect of willow removal on habitat use by five birds of braided rivers, MacKenzie Basin, New Zealand. *New Zealand Journal of Ecology* 23: 53–60.
- Meurk C.D. 2008: Chapter 8. Vegetation of the Canterbury plains and downlands. In: Winterbourn M., Knox G., Burrows C. and Marsden, I. (eds.) *The Natural History of Canterbury*. Third edition. Canterbury University Press. Pp. 195-250.
- McEwen W.M. 1987: *Ecological Regions and Districts of New Zealand*. Third revised edition in four 1:500,000 maps. Booklet to accompany Sheet 3: descriptions of districts in central New Zealand, from eastern Wairarapa to Akaroa, also Chathams, not shown on map. Publication No. 5 (in four parts). Part 3. New Zealand Biological Resources Centre, Department of Conservation, Wellington. 137 pp.
- NIWA 2021: Climate change scenarios for New Zealand. (Accessed 22 September 2021).
- O'Donnell C.F.J. 2000: The Significance of river and open water habitats for indigenous birds in Canterbury, New Zealand. Unpublished report U00/37 for Environment Canterbury. 74 pp.
- Pattle Delamore 2021: Canterbury hapua fish survey pilot study. Prepared for Environment Canterbury. 30 pp.
- Richardson J. and Taylor M.J. 2002: A guide to restoring inanga habitat. Reprinted with minor revisions 2004. NIWA Science and Technology Series No. 50. 31 pp.

Robertson H.A., Baird K., Elliott G.P., Hitchmough R.A., McArthur N.,Makan T.D., Miskelly C.M., O'Donnell C.F.J., Sagar P.M., Scofield R.P., Taylor G.A. and Michel P. 2021: Conservation status of New Zealand birds, 2021. *New Zealand Threat Classification Series 36*. Department of Conservation, Wellington. 43 pp.

Tipa and Associates 2015: Cultural values for the Rangitata Catchment. Draft report prepared for Environment Canterbury. 45 pp.

Sirvid P.J., Vink C.J., Fitzgerald B.M., Wakelin M.D., Rolfe J., and Michel P. 2020: Conservation status of New Zealand Araneae (spiders), 2020. *New Zealand Threat Classification Series 34*. Department of Conservation, Wellington. 33 pp.

VEGETATION AND HABITAT TYPES RECORDED AT RANGITATA HĀPUA, RANGITATA RIVER

The vegetation and habitat types recorded at Rangitata hāpua during the July 2021 site visit and by analysis of aerial imagery are listed below. The distribution of these vegetation and habitat types is illustrated in Figure 2.

1. Radiata pine forest (shelterbelt)

Small areas of shelterbelts and scattered trees of radiata pine are planted on the northwestern margin of Management Unit B. The trees are unlikely to be planted within the footprint of the site.

2. Poplar and crack willow forest

A contiguous area of poplar and crack willow forest is located on the southwest margin of Management Unit B. The understorey of this forest contains gorse, blackberry (*Rubus fruticosus*), exotic grasses such as cocksfoot (*Dactylis glomerata*) and tall fescue (*Lolium arundinaceum* subsp. *Arundinaceum*), and indigenous species including karamū (*Coprosma robusta*), swamp kiokio, kōhūhū and pūrei.

3. Blackberry and old man's beard vineland

Small areas of what appears to be blackberry are located near the northwest boundary of Management Unit A. If these are blackberry vinelands, they are likely to contain dense old man's beard (*Clematis vitalba*). Gorse and Scotch broom are also likely present.

Alternatively, these areas may be young willow.

4. Indigenous shrublands

Small areas of indigenous shrubland that likely comprise saltmarsh ribbonwood are located near the southwestern corner of Management Unit A. Other indigenous shrub species may also occur within these shrublands.

5. Gorse and Scotch broom shrubland

Areas of gorse and Scotch broom shrubland are located on the old braid plain within Management Unit A and the areas inland of the lagoon. Within Management Unit A, these shrublands also contain tree lupin (*Lupinus arboreus*), and are mixed with exotic grassland and gravelfield.

6. Exotic grassland

Areas of exotic grassland that primarily contain cocksfoot and tall fescue are present within both Management Unit A and B. The areas of grassland in Management A have been colonised by scattered gorse and tree lupins.

7. Gravel- and sandfield (including gravel tracks)

Areas of gravelfield and sandfield occur throughout the site within braid plain and shingle beaches. Four wheel drive tracks are included within this habitat type.

8. Streams, rivers and lagoons

Spring-fed streams occur within Management Unit A. Lagoons are located in Management Unit A and B.



Figure 2. Vegetation and habitats at Rangitata Hāpua, Rangitata River, South Canterbury

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AVIFAUNA SPECIES RECORDED ON EBIRD NEAR THE RANGITATA HĀPUA, RANGITATA RIVER

Scientific Name	Common Name	Threat Classification ¹
Indigenous		
<i>Anas gracilis</i>	Grey teal	Not Threatened
<i>Anas superciliosa x platyrhynchos</i>	Grey duck – mallard hybrid	Not Threatened
<i>Anas rhynchotis</i>	Australasian shoveler	Not Threatened
<i>Anarhynchus frontalis</i>	Wrybill	Threatened-Nationally Increasing
<i>Aythya novaeseelandiae</i>	New Zealand scaup	Not Threatened
<i>Charadrius bicinctus bicinctus</i>	Banded dotterel	At Risk-Declining
<i>Chlidonias albostratus</i>	Black-fronted tern	Threatened-Nationally Endangered
<i>Circus approximans</i>	Swamp harrier	Not Threatened
<i>Cygnus atratus</i>	Black swan	Not Threatened
<i>Egretta novaehollandiae</i>	White-faced heron	Not Threatened
<i>Haematopus finschi</i>	South Island pied oystercatcher	At Risk – Declining
<i>Haematopus unicolor</i>	Variable oystercatcher	At Risk-Recovering
<i>Himantopus himantopus leucocephalus</i>	Pied stilt	Not Threatened
<i>Hirundo neoxena neoxena</i>	Welcome swallow	Not Threatened
<i>Hydroprogne caspia</i>	Caspian tern	Threatened-Nationally Vulnerable
<i>Larus bulleri</i>	Black-billed gull	At Risk-Declining
<i>Larus dominicanus dominicanus</i>	Southern black-backed gull	Not Threatened
<i>Larus novaehollandiae scopulinus</i>	Red-billed gull	At Risk-Declining
<i>Morus serrator</i>	Australasian gannet	Not Threatened
<i>Phalacrocorax carbo novaehollandiae</i>	Black shag	At Risk – Relict
<i>Phalacrocorax melanoleucos brevirostris</i>	Little shag	At Risk – Relict
<i>Phalacrocorax melanoleucos melanoleucos</i>	Little pied shag	Non-resident Native – Vagrant
<i>Phalacrocorax varius varius</i>	Pied shag	At Risk-Recovering
<i>Porphyrio melanotus</i>	Pūkeko	Not Threatened
<i>Rhipidura fuliginosa fuliginosa</i>	South Island fantail	Not Threatened
<i>Stercorarius parasiticus</i>	Arctic skua	Non-resident Native – Migrant
<i>Sterna striata striata</i>	White-fronted tern	At Risk-Declining
<i>Stictocarbo punctatus punctatus</i>	Spotted shag	Threatened-Nationally Vulnerable
<i>Tadorna variegata</i>	Paradise shelduck	Not Threatened
<i>Todiramphus sanctus vagans</i>	New Zealand kingfisher	Not Threatened
<i>Vanellus miles novaehollandiae</i>	Spur-winged plover	Not Threatened
<i>Zosterops lateralis lateralis</i>	Silvereye	Not Threatened
Exotic		
<i>Alauda arvensis</i>	Skylark	Introduced and naturalised
<i>Anas platyrhynchos</i>	Mallard	Introduced and Naturalised
<i>Branta canadensis</i>	Canada goose	Introduced and naturalised
<i>Carduelis carduelis</i>	Goldfinch	Introduced and naturalised
<i>Carduelis chloris</i>	Greenfinch	Introduced and naturalised

¹ Robertson *et al.* 2021.

Scientific Name	Common Name	Threat Classification¹
<i>Carduelis flammea</i>	Redpoll	Introduced and naturalised
<i>Columba livia</i>	Rock pigeon	Introduced and naturalised
<i>Cygnus olor</i>	Mute swan	Introduced and naturalised
<i>Emberiza citronella</i>	Yellowhammer	Introduced and naturalised
<i>Fringilla coelebs</i>	Chaffinch	Introduced and naturalised
<i>Gerygone igata</i>	Grey warbler	Introduced and naturalised
<i>Gymnorhina tibicen</i>	Australian magpie	Introduced and naturalised
<i>Passer domesticus</i>	House sparrow	Introduced and naturalised
<i>Prunella modularis</i>	Dunnoek	Introduced and naturalised
<i>Sturnus vulgaris</i>	Starling	Introduced and naturalised
<i>Turdus merula</i>	Blackbird	Introduced and naturalised

INDIGENOUS FISH SPECIES RECORDED AT RANGITATA HĀPUA, AND THE IMPORTANCE OF THE HABITAT FOR EACH SPECIES

Common Name	Scientific Name	Threat Classification	Residence	Spawning	Migration	Important Habitats in Hāpua	Important Habitats in River
Black flounder	<i>Rhombosolea retiaria</i>	Not Threatened	Critical	Unknown	Critical	Lagoon bottom	-
Bluegill bully	<i>Gobiomorphus hubbsi</i>	At Risk – Declining	Important	Important	Critical	Riffles	Riffles in side braids
Common bully	<i>Gobiomorphus cotidianus</i>	Not Threatened	Important	Important	Important	Complex cover (stones, wood)	Side braids, upwellings
Freshwater shrimp	<i>Paratya curvirostris</i>	Not Threatened	Important	Important	Critical	Aquatic plants	-
Giant bully	<i>Gobiomorphus gobioides</i>	At Risk – Naturally Uncommon	Critical	Critical	Critical	Complex cover (stones, wood)	-
Inanga	<i>Galaxias maculatus</i>	At Risk – Declining	Critical	Critical	Critical	Streams, backwaters and vegetated tidal areas	-
Lamprey	<i>Geotria australis</i>	Threatened – Nationally Vulnerable	Not resident	N/A	Critical	-	Space under large stable boulders
Longfin eel	<i>Anguilla dieffenbachii</i>	At Risk – Declining	Important	N/A	Critical	Complex cover (stones, wood)	Riffles when small, then large woody debris
Shortfin eel	<i>Anguilla australis</i>	Not Threatened	Important	N/A	Critical	Complex cover (stones, wood)	Under stones, cover in wetlands and streams
Stokell's smelt	<i>Stokellia anisodon</i>	At Risk – Naturally Uncommon	Not resident	Critical	Critical	Sandy bars and shallows	-
Common smelt	<i>Retropinna retropinna</i>	Not Threatened	Not resident	Important	Critical	Sandy bars and shallows	Sandy bars and shallows
Torrentfish	<i>Cheimarrichthys fosteri</i>	At Risk – Declining	Important	Important	Critical	Riffles	Riffles in side braids
Upland bully	<i>Gobiomorphus breviceps</i>	Not Threatened	Important	Important	N/A	Complex cover (stones, wood)	Side braids, upwellings
Yelloweyed mullet	<i>Aldrichetta forsteri</i>	Not Threatened	Not resident	N/A	N/A	Open water of lagoon	-

POTENTIAL MAHINGA KAI RESOURCES THAT COULD BE ESTABLISHED AT RANGITATA HĀPUA, RANGITATA RIVER

Species	Common Name	Threat Status	Mahinga Kai Resource
Plant			
<i>Cordyline australis</i>	Tī kōuka, cabbage tree	Not Threatened	Numerous medicinal, food, fibre uses ¹ .
<i>Nasturtium officinale</i>	Kōwhitiwhiti, watercress	Introduced and Naturalised	Edible leaves, used medicinally for headaches ¹ .
<i>Phormium tenax</i>	Harakeke, flax	Not Threatened	Numerous medicinal, food, fibre, dyes, and construction uses ¹ .
<i>Typha orientalis</i>	Raupō, bullrush	Not Threatened	Numerous medicinal, food, hunting, and construction uses ¹ .
Freshwater Fish			
<i>Geotria australis</i>	Kanakana, piharau, lamprey	Threatened – Nationally Vulnerable	Food ⁴
Freshwater Invertebrate			
<i>Echyridella menziesii</i>	Kākahi, freshwater mussel	At Risk – Declining	Mussel flesh used as food and medicine. Shells used as tools ⁵ .

1. Further information at (requires a search of individual plant species): <https://maoriplantuse.landcareresearch.co.nz/WebForms/default.aspx>.
2. Source: Phillips (1947).
3. <https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/australasian-bittern-matuku/>.
4. https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/piharau.
5. [https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/kakahi#:~:text=Traditionally%2C%20they%20were%20collected%20throughout,as%20a%20rongo%C4%81%20or%20medicine\).](https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/kakahi#:~:text=Traditionally%2C%20they%20were%20collected%20throughout,as%20a%20rongo%C4%81%20or%20medicine).)

ENVIRONMENTAL PEST PLANTS OBSERVED AT RANGITATA HĀPUA, RANGITATA RIVER

Scientific Name	Common Name(s)	Status in the RPMP
<i>Acer pseudoplatanus</i>	Sycamore	Organism of Interest
<i>Clematis vitalba</i>	Old man's beard	Sustained Control
<i>Cupressus macrocarpa</i>	Macrocarpa	Not listed
<i>Cytisus scoparius</i>	Scotch broom	Sustained Control
<i>Iris pseudoacorus</i>	Yellow flag iris	Not listed
<i>Lupinus arboreus</i>	Tree lupin	Not listed
<i>Myricaria germanica</i>	False tamarisk	Organism of Interest
<i>Pinus radiata</i>	Radiata pine	Not listed
<i>Populus alba</i>	White poplar	Not listed
<i>Populus sp.</i>	Unidentified poplar	Not listed
<i>Rubus fruticosus</i>	Blackberry	Organism of Interest
<i>Salix xfragilis</i>	Crack willow	Not listed
<i>Ulex europaeus</i>	Gorse	Sustained Control

GUIDELINES FOR PLANTING AND MAINTAINING INDIGENOUS PLANT SPECIES AT RANGITATA HĀPUA, RANGITATA RIVER

OVERVIEW

The following section provides an overview of the management actions required for the successful planting and establishment of indigenous species at the Rangitata hāpua.

SPECIES SOURCES AND SELECTION

- All indigenous plant species should occur naturally in similar sites within the Low Plains Ecological District.
- All plants should be sourced from Low Plains Ecological District genetic stock or from nearby ecological districts and should generally have been grown from seed to maximise potential genetic diversity.
- A range of indigenous species with different attributes were identified for the plantings (listed in Tables 4 and 5). These include:
 - Trees that will form a mature canopy.
 - Fast growing early successional species.
 - Shrubs that will provide diversity in the understorey.
 - Raupō, harakake and a range of sedges and rushes for planting on riparian margins and in wetlands.
 - Mahinga kai species.
 - Vigorous indigenous species that will quickly colonise the planting areas (e.g. toatoa, *Haloragis erecta*; karamu (*Coprosma robusta*); koromiko, *Veronica salicifolia*); and Ngaio (*Myoporum laetum*). Ngaio is one of the most common coastal plants in north Canterbury, and grows very fast in harsh conditions (it can handle, dry stony ground, salt spray and wind) making it ideal for coastal restoration.
 - Fleshy-fruited species, to provide food for indigenous fauna and to facilitate their dispersal by birds.

PLANT GRADES

- Planter bag (PB) plant grades (ideally 2/3) should preferably be used for most of the plantings as their stature and robustness reduces their vulnerability to light or incidental browsing by herbivorous animal pests (e.g. rabbits, possums), and they are more resilient to frosts and other environmental extremes.
- PB grade plants should also be used for enrichment plantings.

- Where pre-planting site preparation and post-planting monitoring and maintenance are carried out to a high standard, plants in root trainers (RTs) can be used instead of larger (more costly) plants in individual PBs.

PLANT SPACINGS

- Plant trees at 1.5-2 metre spacings (depending on species).
- Plant shrubs at 1 to 2 metre spacings (depending on species).
- Sedges, rushes and grasses should generally be planted at 0.5 metre spacings with the exception of species such as pūrei and toetoe (*Austroderia richardii*) which should be planted at 1 metre spacings.

SITE PREPARATION PRIOR TO PLANTING

- Planting areas should be prepared in mid to late autumn, ideally four to six weeks prior to planting. Individual planting sites should have vegetation cover reduced by spraying 0.4 metre round areas with 10% glyphosate in water.
- Herbicide should be applied by a qualified applicator (Growsafe and Approved Handler certified).
- It is important that existing naturally-occurring indigenous vegetation (especially containing Nationally Threatened/At Risk or locally uncommon species) is not adversely affected by the planting programme. Plantings should be integrated with and enhance existing indigenous vegetation as much as possible, therefore no indigenous vegetation should be removed to facilitate planting.

TIMING OF PLANTING

- In dryland areas, timing of planting will be dictated by the rainfall patterns in the intended planting season but, in general, should be planted from late autumn, once soil moisture levels reach field capacity, through to mid-winter.
- In flooded riparian margins and wetland areas, planting should be undertaken in early-mid spring (September or October, depending on winter rainfall) once standing water in flooded areas has begun to recede. Site visits should be conducted at the wetland restoration areas to determine the timing of planting during the spring when it is planned.

PLANT GUARDS

- In dryland areas, newly-planted trees and shrubs can be decimated by rabbit and hare browse, so protection against browse is critical.
- Individual plant guards should be used to protect each plant if browsing is an issue. They also provide shelter, increased humidity, reduction of moisture loss, and help to prevent unintended herbicide damage.
- Guards should be removed and reused once the foliage of the plants grows out of the top of the guard.

MAINTENANCE OF PLANTS

- In the first 12 months following planting operations, assess plant condition and weed competition every three months.
- For the first two years following planting, plants should be released from environmental weeds a minimum of three times a year by hand weeding or spraying with selective herbicides.
- For up to five years following the planting, further releases from environmental weeds may be required once or twice a year during the growing season by hand weeding or spraying with selective herbicides. When plants are emergent above the surrounding vegetation (typically a grass sward), little further management is required. However, ongoing control of pest plants will be required, particularly before canopy closure is achieved.
- Infill planting to replace plants that have died may be required and should be undertaken during the second or third year after the original planting.

Table 4: Indigenous plant species to be planted in areas of dryland forest at Rangitata hāpua, Rangitata River.

Scientific Name	Common Name	Status	Spacing (m)	Percentage (%)	Quantity
<i>Coprosma crassifolia</i>	thick-leaved coprosma, mikimiki	Not threatened	1	2	200
<i>Coprosma propinqua</i>	mingimingi, mikimiki	Not threatened	1	5	500
<i>Coprosma robusta</i>	karamū	Not threatened	1	5	500
<i>Cordyline australis</i>	cabbage tree, tī kōuka	Not threatened	1.5	5	222
<i>Corokia cotoneaster</i>	korokio	Not threatened	1.5	5	222
<i>Discaria toumatou</i>	matagouri, tūmatakuru	At Risk – Declining	1.5	2	89
<i>Dodonaea viscosa</i>	akeake	Not threatened	1.5	10	445
<i>Griselinia littoralis</i>	broadleaf, kāpuka	Not threatened	1.5	2	89
<i>Helichrysum lanceolatum</i>	niniaio	Not threatened	1.5	2	89
<i>Hoheria angustifolia</i>	narrow-leaved lacebark, houhere	Not threatened	1.5	5	222
<i>Kunzea robusta</i>	kānuka, rawirinui, kopuka	Threatened – Nationally Vulnerable	1.5	5	222
<i>Meliccytus ramiflorus</i>	māhoe, whiteywood	Not threatened	1.5	5	222
<i>Muehlenbeckia complexa</i>	scrub pōhuehue, wire vine	Not threatened	1	2	200
<i>Myoporum laetum</i>	ngaio	Not threatened	2	10	250
<i>Myrsine australis</i>	red māpou, red matipo	Not threatened	1.5	5	222
<i>Olearia paniculata</i>	akiraho	Not threatened	1.5	9	400
<i>Ozothamnus leptophyllus</i>	tauhinu, cottonhead	Not threatened	1.5	5	222
<i>Phormium tenax</i>	lowland flax, harakeke	Not threatened	1	5	500
<i>Pseudopanax arboreus</i>	five-finger, whauwhaupaku	Not threatened	1.5	5	222
<i>Solanum laciniatum</i>	poroporo	Not threatened	1.5	2	89
<i>Sophora microphylla</i>	kōwhai, weeping kōwhai, small-leaved kōwhai	Not Threatened			
<i>Sophora prostrata</i>	dwarf kōwhai, prostrate kōwhai	Not threatened	1.5	2	89
<i>Veronica salicifolia</i>	koromiko	Not threatened	1	2	200
Total				100	5,416

Table 5: Indigenous plant species to be planted along riparian margins at Rangitata hāpua, Rangitata River.

Scientific Name	Common Name	Conservation Status	Spacing (m)	Percentage (%)	Quantity
<i>Austroderia richardii</i>	Toetoe	Not threatened	1	10	1,000
<i>Apodasmia similis</i>	Oioi	Not threatened	0.5	5	2,000
<i>Ficinia nodosa</i>	Club rush, wīwī	At-Risk Declining	0.5	5	2,000
<i>Carex geminata</i>	Cutty grass, rautahi	Not threatened	0.5	5	2,000
<i>Carex maorica</i>	Cutty grass, rautahi	Not threatened	0.5	5	2,000
<i>Carex secta</i>	Pūrei, pūkio	Not threatened	1	5	500
<i>Carex virgata</i>	Swamp sedge	Not threatened	0.5	5	2,000
<i>Coriaria sarmentosa</i>	Tutu	Not threatened	1	5	500
<i>Eleocharis acuta</i>	Sharp spike sedge	Not threatened	0.5	5	2,000
<i>Juncus edgariae</i>	Leafless rush, wī	Not threatened	0.5	5	2,000
<i>Juncus kraussii</i>	Sea rush	Not threatened	0.5	5	2,000
<i>Juncus sarophorus</i>	Leafless rush, wī	Not threatened	0.5	5	2,000
<i>Phormium tenax</i>	Lowland flax, harakeke	Not threatened	1	20	2,000
<i>Schoenoplectus pungens</i>	Three-square	Not threatened	0.5	5	2,000
<i>Typha orientalis</i>	Raupō, bull rush	Not threatened	0.5	5	2,000
<i>Plagianthus divaricatus</i>	Saltmarsh ribbonwood, mākaka	Not threatened	1.5	5	222
Total				100	26,222

SUMMARY OF MANAGEMENT ACTIONS AND PRIORITIES FOR RANGITATA HAPUA RESTORATION WORK PLAN

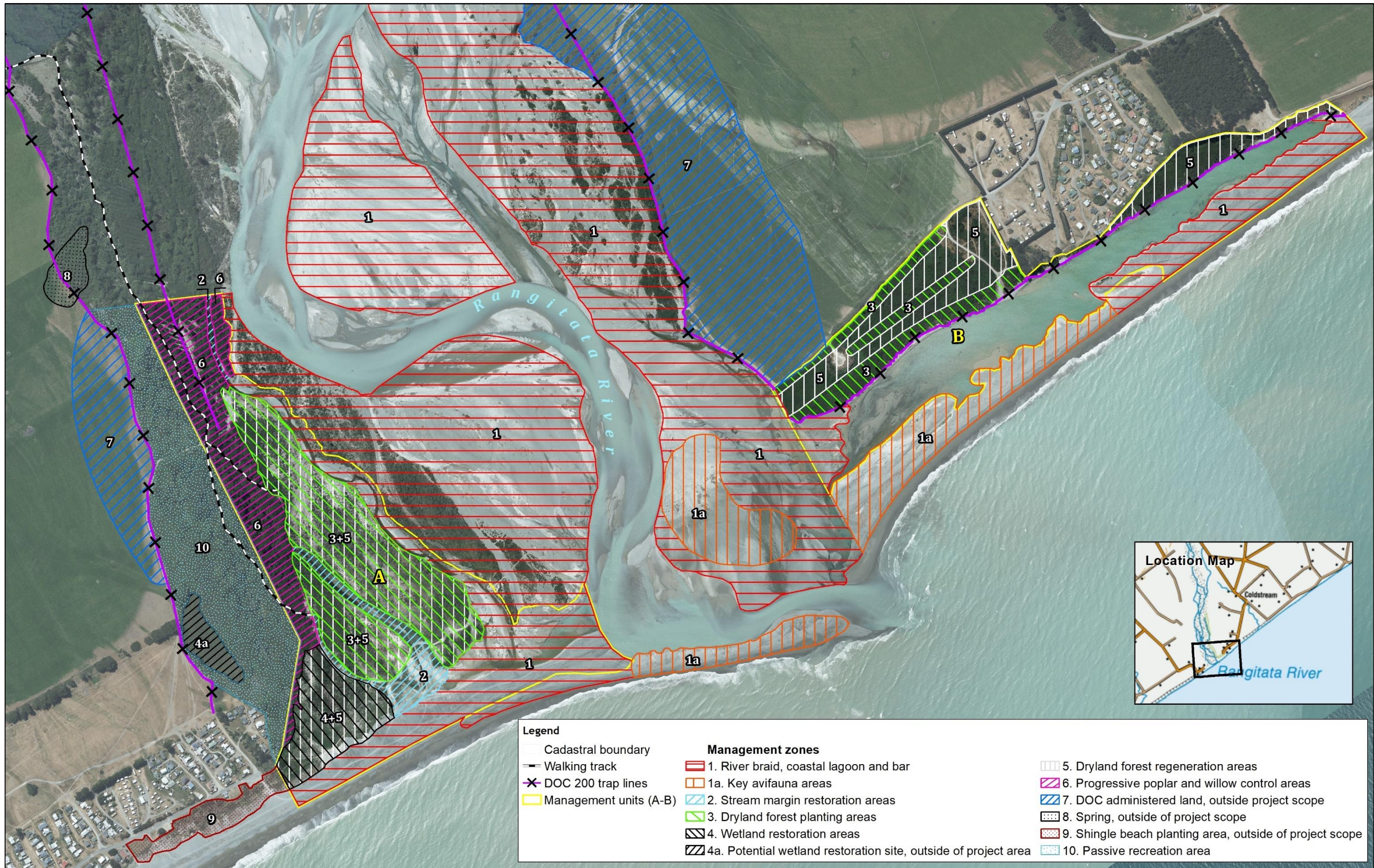
Key Objectives and Actions for Management Zones identified in Figure 3

1. River braid, coastal lagoon and bar: Recognise and promote dynamism, woody weed control to promote bird habitat, karoro control, maintain natural flows and the associated diversity of main stream habitats, advocate for protection of flow and water quality, localised management of recreational and predator pressures around key avifauna sites as required.
2. Stream margin restoration areas: protect and enhance habitat for mahinga kai in spawning creeks, maintain flows by further remedying existing diversions and not allowing diversions of flow in the future, riparian planting to support spawning habitat.
3. Dryland forest planting areas: Reintroduce dryland forest species, section of area only, control woody weeds and plant, ongoing pest plant control, consider opportunities to involve residents of the Rangitata Huts.
4. Wetland restoration areas: Reintroduce wetland species, control woody weeds and plant, survey for other threats and manage as required, ongoing pest plant control, consider opportunities to involve residents of the Rangitata Huts.
5. Dryland forest regeneration areas: Areas for passive vegetation establishment following regeneration from plantings.
6. Progressive poplar and willow control areas: Selective poplar and willow control to promote indigenous plant species regeneration.
7. DOC administered land, outside project scope: retain to allow for potential hāpua retreat in response to sea-level rise and river dynamism.
8. Spring, outside project scope: outside the scope of the restoration plan, actions to protect headwaters of spawning streams and planting to be considered.
9. Shingle beach planting area, outside project scope: outside the scope of the restoration plan, planting shingle beach plant species to be considered.
10. Passive recreation area: outside the scope of the restoration plan, actions may include development of track to State Highway One and interpretation in recognition of the Rangitata as an important travel route.
11. Whole area: predator control, survey for unknown habitats and values, control false tamarisk, yellow flag iris and other pest plants identified as conservation priorities, ensure ECan flood protection works are sympathetic to ecological values and the general principal of dynamism, work with Te Rūnanga o Arowhenua to identify and implement other actions to enhance the ecological integrity, mauri and provision of mahinga kai, implement other actions as identified in the Main Stem restoration plan.

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Freshwater fauna and habitat survey	River braid, side streams, wetlands	Identify to identify and prioritise restoration areas	ASAP	Identify/confirm priority areas
Undertake pest plant survey at the site	Whole site	This survey will identify all pest plants present and control priorities needed	ASAP	Develop pest plant management plan
Develop pest plant management plan	Priority sites identified in surveys	Identify all problematic pest plants and priority areas and species for control	After pest plant survey	Pest plants have the potential to modify the functionality of the braided river system, impacting mahinga kai resources, reducing nesting habitat for indigenous birds and inhibit the regeneration of indigenous vegetation. The complete removal of the gorse and Scotch broom shrubland is recommended to be staged over four years. False tamarisk and yellow flag iris are to be controlled annually across the entire site.
Refine restoration plan after survey	Stream margins / Zone 2 Dryland forest / Zone 3 & 5 Wetlands / Zone 4	Define restoration areas, priorities, plant numbers, and appropriate species list	After habitat survey	Better defining areas will allow for more accurate plant number calculations – need for ordering eco-sourced plants
Order eco-sourced plants and planting materials	Stream margins / Zone 2 Dryland forest / Zone 3 & 5	Order eco-sourced plants and planting materials (plant guards etc.) Refer to Appendix 6 table 4 & 5 for suitable planting species.	ASAP after refining restoration plan	Eco-sourcing is important for the local ecological integrity. Eco-sourcing plants can be a long process. Plants need to be ordered as soon as possible. Not all species will need to be guarded.
Establish photopoints	All areas	Establish photopoints where ecological restoration will occur	Prior to restoration	Good monitoring tool to observe progress and help with future restoration projects
Pest animal control	Perimeter River braid / Zone 1	Establish and install DOC 200 pest animal traps around site perimeter and within areas of braid plain/barrier to protect ground-nesting indigenous birds	Spring/ Summer (March-July 2022) On-going - check monthly	Vital to sustain indigenous bird species reliant on braided river habitat – particularly before and during key bird nesting periods
Assess and remove traps (if required)	River braid / Zone 1	An assessment of traps within flood-prone areas of braid plain. Removing (if required), prior to winter/spring floods	Winter (July 2022)	Traps placed within the river braid to enhance breeding success of nesting birds may need to be removed during winter when the risk of flooding increases.
Black back gull control	River braid / Zone 1	Black back gull control	Spring	Black-back gulls are a dominant species and will displace At-Risk and Threatened indigenous braided river bird species. If required, control should be undertaken in spring during the early part of the black back gull breeding season.

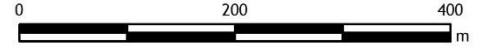
Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Pest plant control	River braid / Zone 1 Stream margins / Zone 2 Dryland forest / Zone 3 & 5 Wetlands / Zone 4	Target pest plant species (Refer Appendix 5). Spot spray, cut and paste or digger vegetation removal. Depending on extent of exotic species present and their proximity to waterways.	After pest plant management plan has been developed-April 2022	Pest plants have the potential to modify the functionality of the braided river system, impacting mahinga kai resources, reducing nesting habitat for indigenous birds and inhibit the regeneration of indigenous vegetation. Priority target areas are within planting zones. The complete removal of the gorse and Scotch broom shrubland is recommended to be staged over four years. Any existing naturally-occurring indigenous vegetation should be identified and flagged (using suitable flagging tape), so as not to be removed, or damaged during pest plant control.
Note: Planting and site preparation efforts have been split to make it more manageable timewise, with a second site preparation and planting phase to be undertaken in either the follow spring or Autumn to ensure maximum plant survival.				
Mark out planting zones	Dryland forest / Zone 3 (and Zone 6)	Suitable areas for planting within dryland zones to be identified and marked out	Summer/Autumn 2022	Planting clumps or strips of indigenous vegetation within these zones will provide seed source to promoted natural regeneration into the surrounding pest plant control zones. Areas with greatest soil depth and leaf mulch should be selected for planting to ensure maximum survival. Low lying areas prone to flooding should be avoided. Existing naturally-occurring indigenous vegetation should be re-identified and flagged (if flagging no longer present) Where possible planting should be integrated with existing indigenous vegetation.
Planting site preparation	Side Stream margins / Zone 2 Dryland forest / Zone 3 Wetlands / Zone 4 & 4a*	Follow up control of any pest plants that have survived or regenerated following initial control – within planting zones. Spot spray planting sites (0.4 metre round areas with 1% glyphosate or other suitable herbicide depending on target species and time of year).	Mid to late autumn. At least one month prior to planting	This is important for successful establishment of planted species and makes it easier and/or more efficient for planting. All pest plant control should be undertaken by experienced Growsafe certified operators.
Planting	Dryland forest / Zone 3	Plant and guard species were necessary. Plant at 1 – 1.5 m spacing for shrub/tree species. Refer: Appendix 6, Table 4 – for planting list and specifications.	Autumn 2022 At least one month after site preparation	Create a seed source for future natural regeneration, and enhance current habitats. In dryland areas planting should be undertaken from late autumn through to mid-winter. Once soil moisture levels reach full capacity.
Planting site maintenance	Dryland forest / Zone 3	Spray (Glyphosate) or hand release plants from weeds and pest plants as required.	At least 3-4 visits over Spring-Summer for the first 3 years - after planting. Then ongoing as required until plantings have established	This is vital for the successful establishment of the planting areas. Invading weeds can quickly establish and complete/outgrown planted species.
Mark out planting zones	Side Stream margins / Zone 2 Wetlands / Zone 4 & 4a*	Mark out planting areas along the riparian stream margins and wetland margins.	Late winter / early spring 2022	Clearly identify the planting zones to prior to site preparation. A number small, unmapped wetland areas in Zone 4 will need to be investigated, with suitable planting areas identified marked out. *Wetland area Zone 4a was outside of original project area. Planting feasibility and restoration potential will need to be assessed. Existing naturally-occurring indigenous vegetation should be re-identified and flagged (if flagging no longer present) Where possible planting should be integrated with existing indigenous vegetation.
Planting site preparation	Side Stream margins / Zone 2 Wetlands / Zone 4 & 4a*	Follow up control of any pest plants that have survived or regenerated following initial control – within planting zones. Spot spray planting sites (0.4 metre round areas with 1 to 1.5% glyphosate or other suitable herbicide depending on target species and time of year). Manual control such as 'cut and paste' or 'grubbing' of weeds/pest plants may need to be done if plants are overhanging the water.	Early spring 2023 At least one month prior to planting	This is important for successful establishment of planted species and makes it easier and/or more efficient for planting.
Planting	Side Stream margins / Zone 2 Wetlands / Zone 4 & 4a	Plant and guard species were necessary. Plant at 0.5m spacing for sedges and rushes. 1 – 1.5 m spacing for harakeke, toetoe and shrub species. Refer to Appendix 6 table 5 for planting list and specifications.	Spring 2023. At least one month after site preparation	Create a seed source for future natural regeneration, and enhance current habitats such as the wetlands and river stream margins
Planting site maintenance	All Planted areas	Spray (Glyphosate) or hand release plants from weeds and pest plants as required.	At least 3-4 visits over Spring-Summer for the	This is vital for the successful establishment of the planting areas. Invading weeds can quickly establish and complete/outgrown planted species.

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
		Control gorse, broom and other woody pest plant regeneration as required – using suitable herbicide and experienced growsafe certified operators.	first 3 years - after planting. Then ongoing as required until plantings have established	
Undertake feasibility assessment for willow and poplar control	Poplar and crack willow forest Zone 6	Assess feasibility and undertake poplar and crack willow control. Identify area for control and suitable control methods. Apply for resource consent if required.	Autumn 2022	The removal of the poplar and crack willow forest should be stage over three – four years. Staging the removal will reduce the risks of bank destabilisation and allow for trial and development of the best restoration treatments, that can then be deployed across the wider site.
Willow and poplar control (If assessed as feasible)	Poplar and crack willow forest Zone 6	Drill and inject poison into large adults, cut and paste juveniles or foliar spray seedlings within target areas.	Spring – Autumn 2023	Willows and poplars have a range of impacts including altering river channels, shading out indigenous vegetation and reducing in-stream invertebrate abundance.



Legend	
	Cadastral boundary
	Walking track
	DOC 200 trap lines
	Management units (A-B)
Management zones	
	1. River braid, coastal lagoon and bar
	1a. Key avifauna areas
	2. Stream margin restoration areas
	3. Dryland forest planting areas
	4. Wetland restoration areas
	4a. Potential wetland restoration site, outside of project area
	5. Dryland forest regeneration areas
	6. Progressive poplar and willow control areas
	7. DOC administered land, outside project scope
	8. Spring, outside of project scope
	9. Shingle beach planting area, outside of project scope
	10. Passive recreation area

Figure 3. Priority areas at Rangitata hāpua, Rangitata River, South Canterbury



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SITE PHOTOGRAPHS



Plate 1: A view of the hāpua in Management Unit A. The image was taken from the coastal barrier beach on the southeastern side of the management unit. 8 July 2021.



Plate 2: The southwestern margin of the hāpua within Management Unit A. Areas of wetland within this part of Management Unit A could be a useful site for the restoration of mahinga kai plant species. 8 July 2021.



Plate 3: Potential īnanga spawning habitat along the margins of side braids within Management Unit A are being restored through the control of pest plants and the planting of indigenous vegetation. The margins of the smaller spring-fed streams within the site should also be restored in this manner. 8 July 2021.



Plate 4: Areas of gorse and Scotch broom shrubland within Management Unit A could potentially be cleared to improve habitat for indigenous fauna. 8 July 2021.



Plate 5: The area of poplar and crack willow forest within Management Unit A could act as an area to trial restoration treatments to be deployed across the wider catchment. 8 July 2021.



Plate 6: A view, looking east, of the hāpua within Management Unit B. 8 July 2021.



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